



Centennial Coal



Environmental Assessment

Myuna Colliery

Section 75W Modification to Project Approval PA 10_0080

November 2014



EXECUTIVE SUMMARY

Myuna Colliery is an underground coal mine owned and operated by Centennial Myuna Pty Limited (CMPL). Myuna Colliery is located 25 kilometres south-west of Newcastle, New South Wales (NSW) in the Lake Macquarie and Wyong Local Government Areas (LGA).

Myuna Colliery is owned and operated by CMPL, which is a wholly owned subsidiary of Centennial Coal Company Limited (Centennial). Centennial is a wholly owned subsidiary of Banpu Public Company Limited (Banpu).

In August 2014 it became necessary to place the Newstan Colliery back into 'care and maintenance'. At the time Newstan Colliery employed 148 people. Centennial identified the ability to transfer workers from the Newstan Colliery to Myuna Colliery as a way to reduce the impact of job losses and the associated costs that might otherwise be imposed on local and regional communities and all levels of government.

The additional workforce relocating to Myuna Colliery will result in the operation of additional mining equipment underground, consequently increasing the rate of production from the Myuna Colliery. The increase in production will assist in providing flexibility to Centennial in meeting local coal supply contracts that would have otherwise been provided through the ongoing operations at the Newstan Colliery.

CMPL has current approval to extract up to 2 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal and employ 210 full time employees.

This Environmental Assessment (EA) has been prepared to support an application by CMPL to modify Project Approval 10_0080 pursuant to Section 75W of Part 3A of the EP&A Act to allow for:

- an increase in run of mine (ROM) coal extraction to up to 3 million tonnes per annum; and
- an increase in employment to up to 300 full time employees.

The Modification Application Area encompasses PA10_0080 which includes ML 1370, MPL334, a portion of CCL 762 and the Myuna Colliery Surface Facilities Area. The Modification Application Area is external to the Development Consent SH110_148, with the exception of the inclusion of the Surface Facilities Area.

Myuna Colliery's Surface Facilities Area is located on Wangi Point Road, west of the residential area of Arcadia Vale, north-west of Wangi Wangi and is adjacent to the site of the former Wangi Power Station.

The proposed modification has been assessed using a risk-based approach to appropriately identify and assess potential environmental impacts. Emphasis has been placed on ensuring minimal changes to the approved operations at the Myuna Colliery. In particular, the proposed modification will not result in any changes to the approved life of the mine, mining method, coal handling, coal transportation, water management or reject management at the Myuna Colliery.

Impacts associated with the proposed modification have been assessed in the EA with the conclusion that the proposed modification will have no environmental consequences beyond those already approved pursuant to Project Approval 10_0080. The Myuna Colliery EMS provides sufficient environmental controls to cater for the proposed modification.

The proposed modification is considered to be consistent with relevant objectives of the EP&A Act and will not change the nature of the development originally approved. On considering the balance of environment and community impacts, it is considered reasonable to conclude that the benefits of the proposed modification outweigh the impacts.

Submission of Environmental Assessment (EA)

Prepared under Section 75W of the *Environmental Planning and Assessment Act 1979*

EA Prepared By:

Name: James Wearne (Environmental Coordinator – Projects)

Qualifications: Bachelor of Environmental Science

Company: Centennial Coal Company Limited

Address: Level 18, BT Tower, 1 Market Street, Sydney, NSW, 2000

Development Application:

Proponent Name: Centennial Myuna Pty Limited

Proponent Address: Level 18, BT Tower, 1 Market Street, Sydney NSW, 2000

Land to be Developed: Myuna Colliery (Refer to existing Schedule of Land for PA 10_0080)

LGA: Lake Macquarie City

Description: Modification to Project Approval PA 10_0080

Declaration:

I hereby certify that I have prepared the contents of this document and to the best of my knowledge:

- It contains all available information that is relevant to the environmental assessment of the proposed development to which the document relates; and
- It is true in all material particulars and does not, by its presentation or omission of information, materially mislead.

Name: James Wearne (Centennial Coal Company Limited)

Date: November 2014

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Appendix D – Groundwater and Water and Salt Balance Review (GHD 2014)

1 INTRODUCTION

1.1 Overview

Myuna Colliery is an underground coal mine owned and operated by Centennial Myuna Pty Limited (CMPL). Myuna Colliery is located 25 kilometres south-west of Newcastle, New South Wales (NSW) in the Lake Macquarie and Wyong Local Government Areas (LGA) (refer to Figure 1).

Lake Macquarie City Council (LMCC) granted Development Consent SH110_148 for the development and operation of the Myuna and Cooranbong Collieries in 1977. The Development Consent was granted pursuant to the provisions of the now repealed *Local Government Act 1919*. The Development Consent remains in force and authorises the extraction of coal within the Development Consent Mining Area as shown on **Figure 2**.

The development of Myuna Colliery commenced in 1979 and underground mining using bord and pillar mining methods commenced in 1982. Newcom Colliery (the original owners and operators of Myuna Colliery) transferred ownership to the State owned entity Elcom Collieries Pty Ltd in 1991. In 1992, ownership of Myuna Colliery was transferred from Elcom Collieries Pty Ltd to ENC (Management) Pty Ltd, which in 1993 was renamed Powercoal Pty Ltd. At this time Powercoal held the NSW Government coal mining assets and was owned by Pacific Power (a NSW Government state owned corporation). In 2002, Centennial Coal Company Ltd acquired all Powercoal assets. CMPL has operated Myuna Colliery since this time.

On 18 January 2012, the (then) Minister of Planning and Infrastructure granted Project Approval (PA) 10_0080 to CMPL. PA 10_0080 authorises the continued mining in areas outside the existing Development Consent SH110_148 mining area and within the boundary of existing mining leases held by CMPL. PA 10_0080 authorises the use of bord and pillar methods in the Wallarah, Great Northern and Fassifern coal seams and the continued use of ancillary infrastructure, for a further 21 years. The Project Approval boundary is shown on **Figure 2**.

CMPL has current approval to extract up to 2 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal and employ 210 full time employees.

This Environmental Assessment (EA) has been prepared to support an application by CMPL to modify Project Approval 10_0080 pursuant to Section 75W of Part 3A of the EP&A Act to allow for:

- an increase in run of mine (ROM) coal extraction to up to 3 million tonnes per annum; and
- an increase in employment to up to 300 full time employees.

The primary components of the proposed modification are summarised below in **Section 1.4** and detailed in **Section 4** of this EA.

This EA contains a focused assessment of the matters pertinent to the proposed modification to a level of detail commensurate with the scale of the proposed modification, industry standards and the legislative framework under which it is permissible.

1.2 The Proponent

Myuna Colliery is owned and operated by Centennial Myuna Pty Ltd, which is a wholly owned subsidiary of Centennial Coal Company Limited (Centennial). Centennial is a wholly owned subsidiary of Banpu Public Company Limited (Banpu).

Centennial is one of the largest underground coal producers in NSW. With coal mines supplying thermal and coking coal to domestic and export markets, Centennial is a major supplier to the NSW energy industry, fuelling approximately 40 percent of the State's coal-fired electricity.

1.3 Project Team

CMPL's project team comprises Mary-Anne Crawford (Group Manager Approvals), Roger Davis (Mine Manager), James Wearne (Environment and Community Co-coordinator, Projects) and Morgan Gleeson (Environment and Community Coordinator).

The following specialist consultants were also engaged and managed by CMPL to assist in the technical and scientific assessment of the proposed modification:

- GHD – Myuna Colliery Modification_Water and Salt Balance;
- Intersect Traffic - Myuna Colliery Modification_Traffic Impact Assessment; and
- SLR – Myuna Colliery Modification_Air Quality Impact Assessment.

1.4 Modification Overview

The (then) Minister of Planning and Infrastructure granted Project Approval 10_0080 to Myuna Colliery under Section 75J of the Environmental Planning and Assessment Act 1979 (EP&A Act) following the submission of the Myuna Colliery Extension of Mining Environmental Assessment (AECOM, 2011). CMPL are seeking to modify Project Approval 10_0080 pursuant to Section 75W of Part 3A of the EP&A Act to allow for:

- an increase in ROM coal extraction to up to 3 million tonnes per annum; and
- an increase in employment to up to 300 full time employees.

Myuna Colliery is a transitional Part 3A Project under the EP&A Act. Transitional provisions have been put in place, with Schedule 6A of the EP&A Act containing savings and transitional arrangements for Part 3A projects. Pursuant to Schedule 6A, Section 75W of Part 3A continues to apply to modifications of the development consents referred to in Clause 8J(8) of the Environmental Planning and Assessment Regulation 2000 (EP&A Regulation). Clause 8J(8) of the EP&A Regulation provides a mechanism whereby major projects approved under Part 3A of the EP&A Act can be modified under Section 75W. PA 10_0080 was granted by the then Minister for Planning on 18 January 2012 under Section 75J of Part 3A of the EP&A Act. Pursuant to Clause 12 of Schedule 6A of the EP&A Act, Myuna Colliery's Project Approval can therefore be modified under Section 75W.

Figure 1 - Location Plan

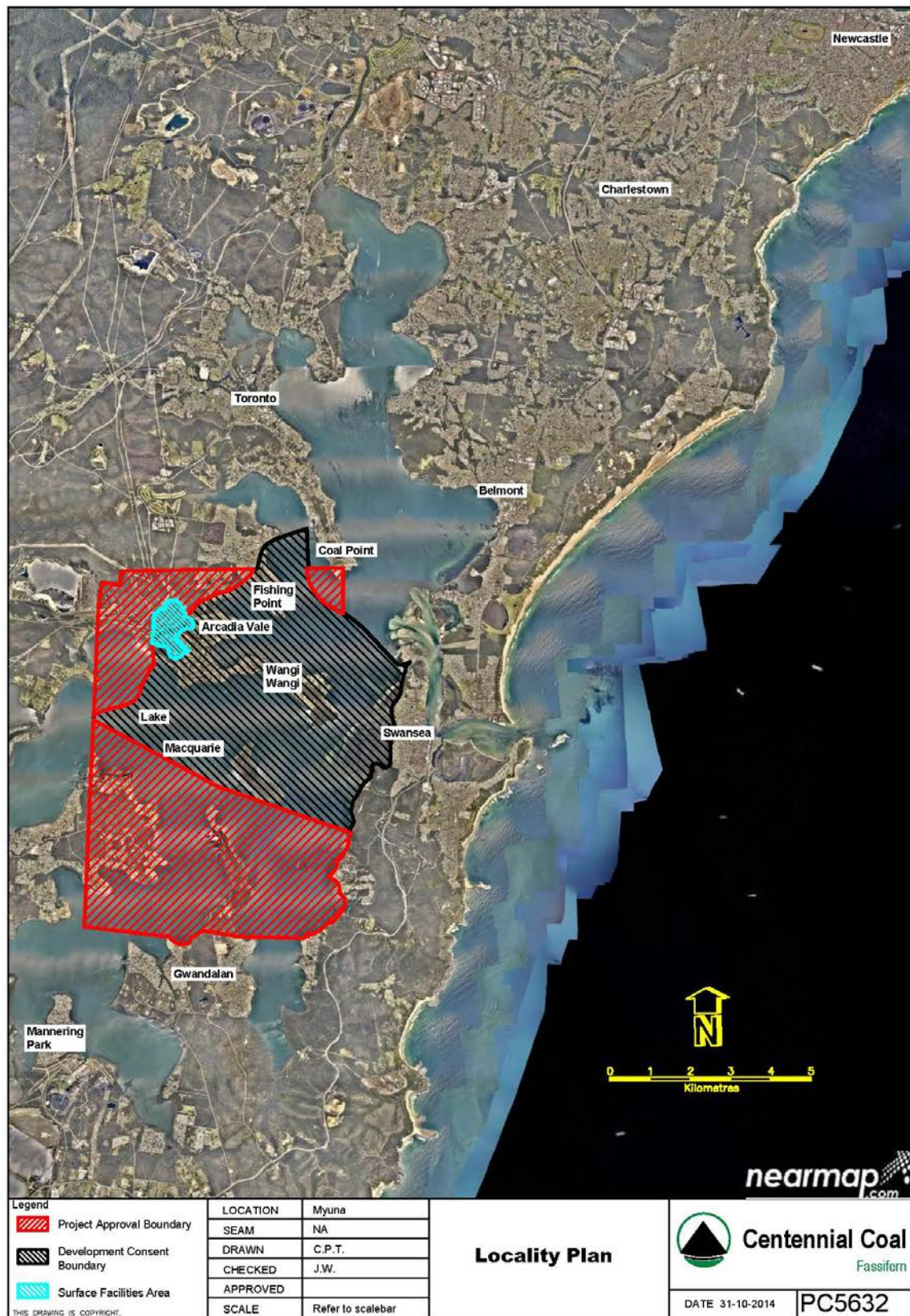
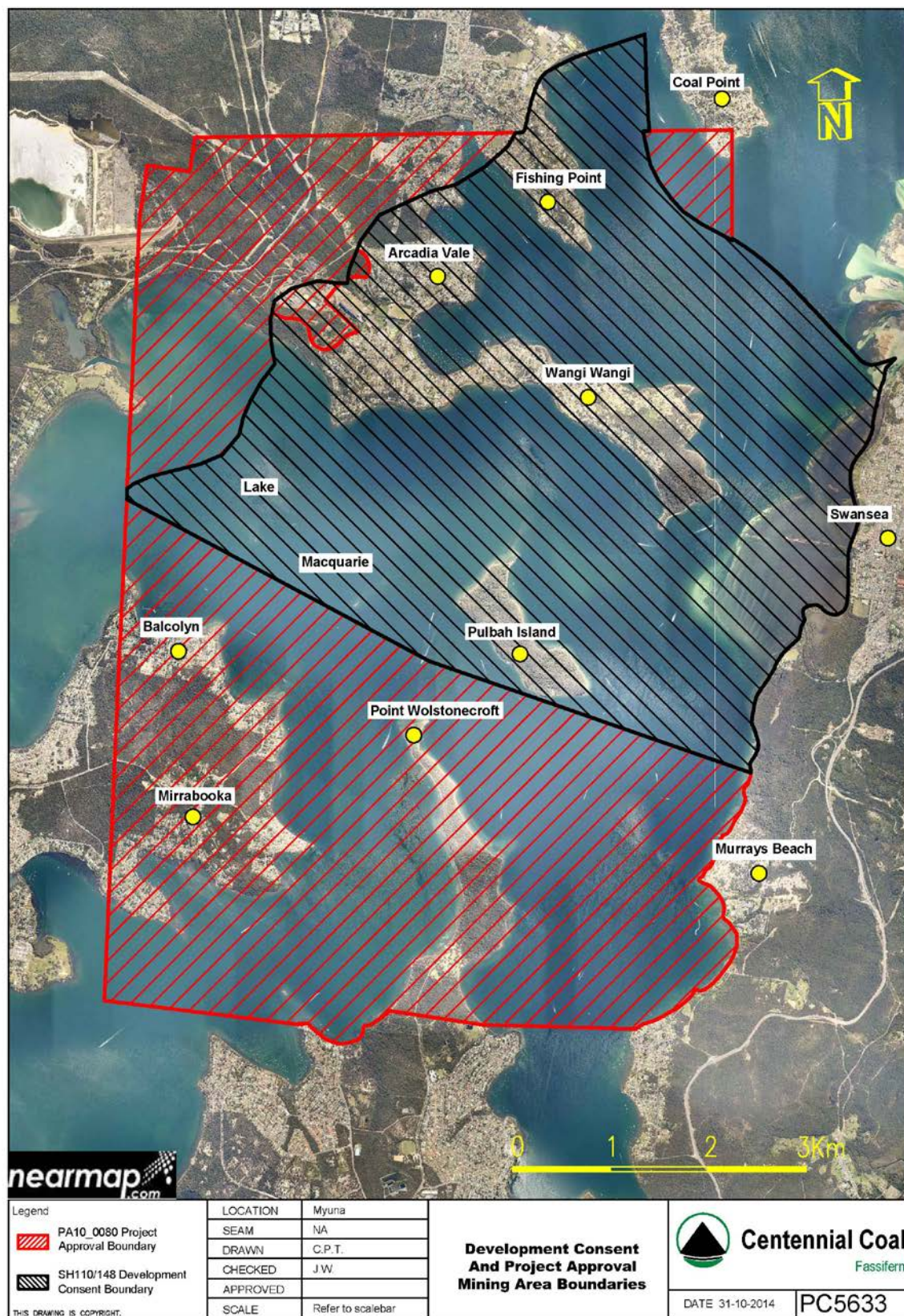


Figure 2 - Development Consent and Project Approval Mining Area Boundaries



1.5 Purpose and Structure of the Environmental Assessment

The purpose of this EA is to enable consideration of the environmental impacts associated with the proposed modification. The EA has been prepared in accordance with the requirements of the Department of Planning and Environment (DP&E) as detailed in email correspondence dated 8 August 2014 (refer to **Appendix A**). In summary, the EA is structured as follows:

Section 1.0 - outlines the background to the proposed modification, introduces the Proponent and project team and nominates the approval pathway.

Section 2.0 - provides an overview of the Modification Application Area in terms of locality, land use, land ownership and sensitive receivers.

Section 3.0 - provides a description of the existing approved operations.

Section 4.0 - provides a description of the proposed modification.

Section 5.0 - describes the approval pathway and environmental legislative framework for the proposed modification.

Section 6.0 - outlines the process used to identify and prioritises the issues to be addressed within the EA.

Section 7.0 - outlines the stakeholder consultation that forms part of the EA.

Section 8.0 - contains a description of the existing environment and an assessment of the environmental impacts of the proposed modification.

Section 10.0 - outlines the justification for the proposed modification and contains the conclusion to the EA.

Section 11.0 - lists the reference documents referred to within the EA.

Section 12.0 - lists the abbreviations used within the EA.

2 SITE DESCRIPTION

2.1 Site Location

Myuna Colliery is located 25 kilometres south-west of Newcastle, NSW in the Lake Macquarie and Wyong LGAs (refer to **Figure 1**).

2.2 Modification Application Area

The Modification Application Area encompasses PA10_0080 which includes ML 1370, MPL334, a portion of CCL 762 and the Myuna Colliery Surface Facilities Area. The Modification Application Area is external to the Development Consent SH110_148, with the exception of the inclusion of the Surface Facilities Area.

The mining area within the Modification Application Area encompasses the Wallarah, Great Northern and Fassifern coal seams. The mining area is predominately positioned beneath Lake Macquarie, and also extends under the suburbs of Arcadia Vale, Wangi Wangi, Myuna Bay, the Morisset Peninsula, Point Wolstoncroft, and to a lesser extent, under the suburbs of Coal Point, Fishing Point and Rathmines.

Myuna Colliery's Surface Facilities Area is located on Wangi Point Road, west of the residential area of Arcadia Vale, north-west of Wangi Wangi and is adjacent to the site of the former Wangi Power Station.

2.3 Land Use

Myuna Colliery's Surface Facilities Area is surrounded by a mix of land uses and types, including mining, industrial, vegetated and residential land, and is proximate to Lake Macquarie.

Lake Macquarie itself is a significant recreation area within the LGA, with activities including recreational fishing, boating, water-skiing and bathing.

Point Wolstoncroft and portions of the foreshore of Myuna Bay within the Modification Application Area form part of the Lake Macquarie State Conservation Area, which is managed by the National Parks and Wildlife Service (NPWS). The Lake Macquarie State Conservation Area includes some 16 kilometres of foreshore vegetated areas and open spaces in six different sections around Lake Macquarie which provide important habitat for native flora and fauna species (NPWS, 2005).

The Modification Application Area comprises portions of vegetated and built up areas, including the residential suburbs of Arcadia Vale, Morisset Peninsula, Coal Point, Fishing Point and Rathmines. The built up areas of the Modification Application Area incorporate man-made surface features and infrastructure such as roads, bridges, sewer and water pumping stations, pipelines, fibre optic cables and electrical transmission lines. The Pacific Highway is the closest major transport route, located on the eastern side of Lake Macquarie, one kilometre east of the Modification Application Area.

There is coal extraction at a number of collieries underneath and surrounding Lake Macquarie including Chain Valley, Mandalong Mine, Mannering and Newstan. With the proximity of coal resources, power generation is also a significant industry in the Lake Macquarie Area, with Eraring Power Station located immediately to the west of the Modification Application Area and Vales Point Power Stations located to the south.

2.4 Sensitive Receivers

A number of residences are located immediately adjacent to the boundary of the Surface Facilities Area. A bushland buffer (owned by Centennial Fassifern Pty Ltd) of at least 500 metres separates the Surface Facilities Area from the residential areas of Wangi Wangi and Arcadia Vale to the east and south of the infrastructure of the Surface Facilities Area, respectively.

The nearest sensitive receiver is located approximately 0.5 km south east of the infrastructure at Myuna Colliery's Surface Facilities Area. A list of the nearest sensitive receptors (nominated as 'R1' to 'R8') identified in the immediate vicinity of the Surface Facilities Area, and their respective distances from the Surface Facilities Area boundary, are presented in **Table 1** and shown on **Figure 4**.

Table 1 - Nearest Sensitive Receptors

Receptor ID	Location	Receptor Location		Distance (km) and Direction from Mine Infrastructure
		Easting (m, UTM)	Northing (m, UTM)	
R1	2 Turrana Street, Wangi Wangi	366,858	6,340,370	0.5 SW
R2	2 Moani Street, Wangi Wangi	366,652	6,340,175	0.5 SE
R3	3 Sunset Close, Wangi Wangi	365,707	6,340,844	0.5 W
R4	119 Donnelly Road, Arcadia Vale	366,662	6,341,662	0.9 N
R5	93 Donnelly Road, Arcadia Vale	366,857	6,341,348	0.7 NNE
R6	83 Donnelly Road, Arcadia Vale	367,049	6,341,185	0.7 NE
R7	63 Donnelly Road, Arcadia Vale	367,091	6,340,965	0.6 NE
R8	53 Donnelly Road, Arcadia Vale	367,072	6,340,821	0.5 NE

2.5 Land Ownership

The Modification Application Area is predominately positioned beneath Lake Macquarie which is NSW Government Crown land. Freehold land is the other predominant land ownership within the Modification Application Area.

Myuna Colliery's Surface Facilities Area is situated on land owned by Centennial Fassifern Pty Ltd, a sister company of CMPL.

Landownership within the Modification Application Area is shown on **Figure 5**.

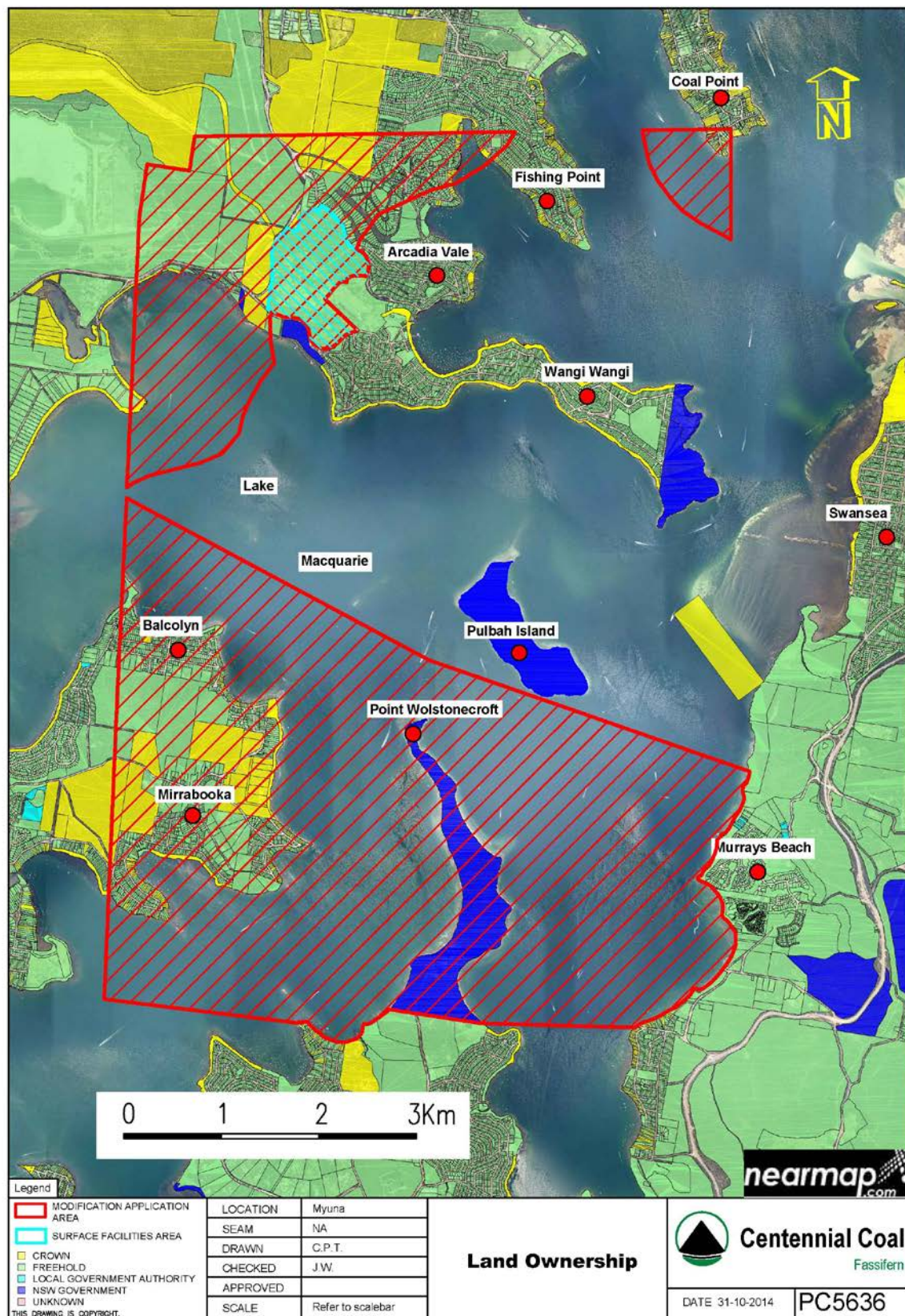
Figure 3 – Modification Application Area



Figure 4 – Sensitive Receivers Surrounding the Surface Facilities Area



Figure 5 – Land Ownership



2.6 Geology, Soils and Topography

Myuna Colliery is located in the northern portion of the Sydney Basin. Myuna Colliery currently mines within the Wallarah, Great Northern, and Fassifern seams of the Newcastle coal measures.

The coal seams mined at Myuna Colliery are part of the late Permian Age Newcastle coal measures, which dips to the south east at a grade of generally less than 1 in 20. The Moon Island Beach, Awaba Tuff and Boolaroo Formations of the Newcastle coal measures outcrop and/or subcrop to the northwest, north, northeast, east and southeast of the Modification Application Area.

The Wallarah Seam ranges in thickness of between 2.0 m to 3.0 m across the Myuna Colliery holding boundary and is predominantly overlain by Karignan Conglomerate, described as a medium to coarse grained pebble conglomerate. The Dooralong Shale makes up the roof of the Wallarah Seam in the east and the Wallarah Seam is underlain by Mannering Park Tuff claystone/mudstone.

The Great Northern seam generally varies in thickness of between 2.5 m to 3.0 m across the holding boundary. Teralba Conglomerate tends to form the roof of the Great Northern seam in most areas, although this is replaced by shale, mudstone or tuffaceous siltstones in some areas. The Awaba Tuff siltstone/claystone underlies the Great Northern seam in most areas.

Both the Wallarah and Great Northern seams tend to split, deteriorate and thin along the north south zone to the west and south west of the holding boundary.

The Fassifern seam is the most extensive coal reserve throughout the lease area, with a thickness in excess of 6.0 m in areas where the seam is not split. The seam is at its greatest thickness at Wangi Point. Between the Wangi Peninsula and Pulbah Island the seam splits in two. The lower split is the preferred mining section in this area. The splits coalesce to the south of Pulbah Island and beyond the Modification Application Area. Awaba Tuff generally overlies the Fassifern seam, while the floor is composed of claystones.

The coal seam stratigraphy within the Modification Application Area is shown on **Figure 6**

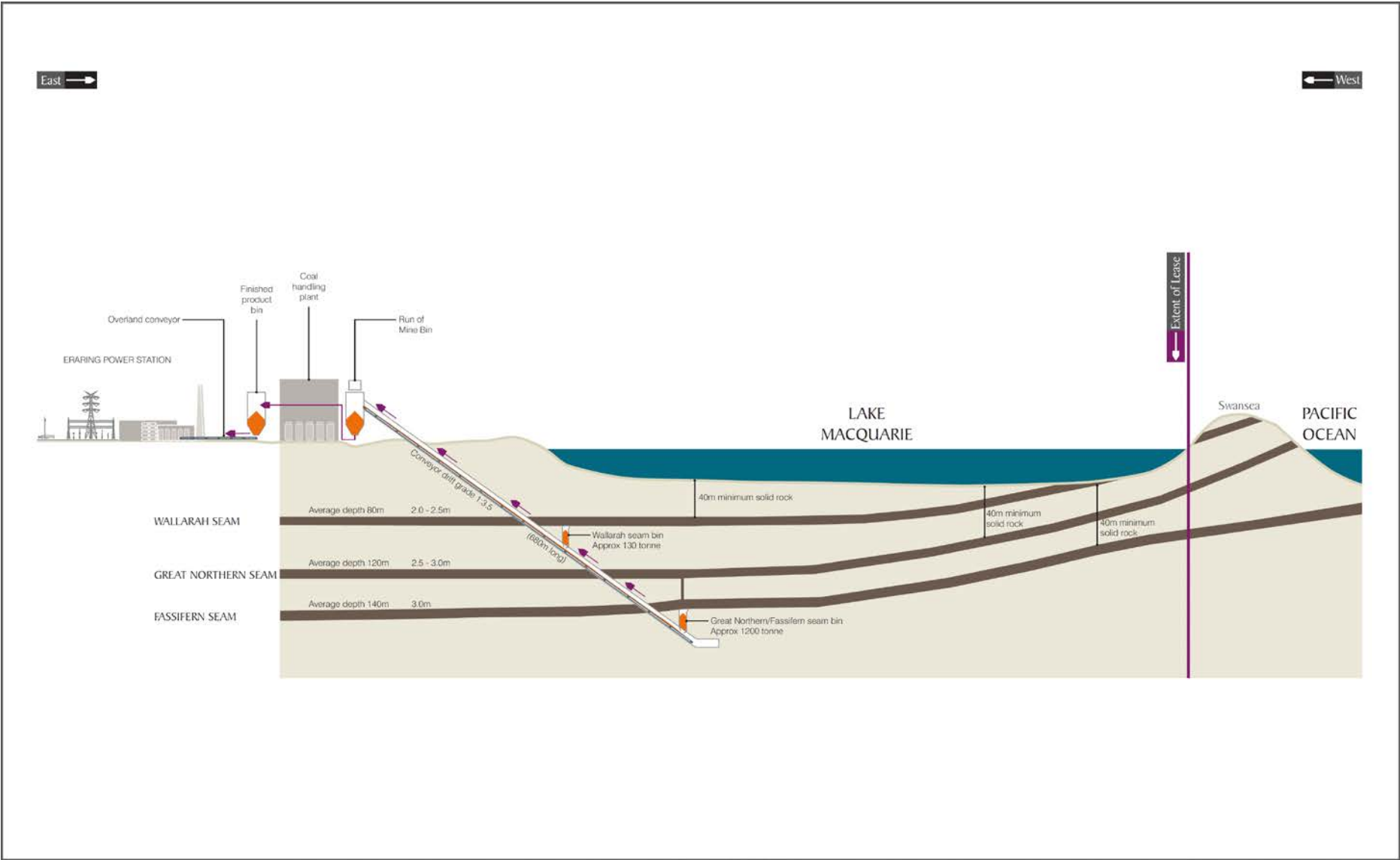
The soil landscapes within the Modification Application Area are characterised by the Awaba, Doyalson and Wyong Soil landscapes.

The topography in both the immediate and regional vicinity of the Surface Facilities Area is classified as uncomplex terrain as it is relatively flat and generally void of steep slopes. Ground elevations range from 0 m AHD to approximately 70 m AHD within the Modification Application Area.

2.7 Climate

The Modification Application Area is likely to experience light to moderate winds (between 1.5 m/s and 5.5 m/s) primarily from the south-east. Calm wind conditions (wind speed less than 0.5 m/s) occur approximately 6% of the time. Ground-based temperature inversions are generally observed on some nights and mornings. Rainfall in the region is typically less during the winter months with higher rainfall generally experienced during the summer months.

Figure 6 - Coal Seam Stratigraphy



3 APPROVED OPERATIONS

3.1 Existing Approvals

The Myuna Colliery comprises the underground workings and associated surface infrastructure, which are currently regulated by the Consent, Approvals, Leases and Licences outlined in **Table 2**.

Table 2 - Myuna Colliery Licences and Approvals

Title	Description	Date Granted	Expiry
Development Consent	SH110\148 - Development of the Myuna and Cooranbong Collieries, as described in the EIS and subject to certain conditions	21/12/1977	N/A
	PA10_0038 - Development of Myuna Colliery as described in the EA and subject to certain conditions.	18/01/2012	31/12/2032
Environment Protection Licence (EPL) 366	Licence authorising discharges to water and Mining for Coal at a rate of 0.5 – 2 Mtpa	01/01/2000	N/A
CCL 762	A title including the area originally comprised in CL 195 for coal or mining purposes of approximately 10,820 hectares	CL 195 granted 8/8/1979, consolidated into CCL 762 in 1991	Renew 13/10/2022
MPL 334	Title to construct and operate prescribed mine related plant and infrastructure of approximately 33 hectares	20/10/1994	Renew 20/10/2015
ML 1370	Title that provides rights to mine the coal resource of approximately 635 hectares	26/9/1995	Renew 02/12/2016
Exploration Licence (EL) 4444	Licence granted to allow exploration to be undertaken to determine the occurrence and extent of the coal resource and to assess the potential for mining of approximately 5,164 hectares	23/10/1992	Renew 23/10/2017
Trade Waste Permit (D 171027)	Permits the discharge of 'prohibited substances' to sewer in accordance with various quality requirements	26/10/1995	N/A
Section 151 Licence (CCHR0910-04)	Installation and Monitoring of Surface Subsidence Stations at Point Wolstoncroft	10/9/2009	Licence currently being renewed
Water Access Licence	Licensing of three existing dewatering bores at the Surface Facilities Area	Licence currently being sought	N/A

3.2 Life of Mine

Myuna Colliery has an approved life until 12 December 2032 pursuant to Project Approval 10_0080.

3.3 Operational Hours

Myuna Colliery is a 24 hour a day, seven day a week operation.

3.4 Operational Employment

Myuna Colliery has approval to employ up to 210 full-time personnel. A variable number of additional contractors are engaged from time to time as required.

3.5 Mining

3.5.1 Mining Area

Underground coal mining has been conducted at Myuna Colliery since 1982. Coal has been recovered from three seams (Wallarah, Great Northern, and Fassifern) within the Project Application area and Development Consent mining area as shown on Figure 1. The majority of mining has been conducted under Lake Macquarie.

3.5.2 Mining Method

The method of extraction for these areas is by conventional underground bord and pillar mining methods. The mining system includes:

- Multiple seam mining – first workings or non-caving partial pillar extraction systems where multiple seams are to be mined; and
- Single seam mining – first workings, partial pillar extraction or wide panel full extraction.

Two subsidence zones have been established at the Myuna Colliery.

- Zone A – Long term stable mining systems generating up to 20 millimetres surface subsidence (i.e. no noticeable surface impacts) on sensitive surface features including land and seagrass beds; and
- Zone B – Mining systems generating up to a maximum of 650 millimetres surface subsidence (under Lake Macquarie).

The proposed subsidence zones are shown on **Figure 7**.

3.5.3 Mining Production

Myuna Colliery has Project Approval to produce up to 2 Mtpa of ROM coal within the Project Approval Area and Development Consent mining area (as shown on **Figure 2**) in any calendar year.

3.5.4 Mine Access

Materials and personnel access to the underground workings is achieved from the Myuna Colliery Surface Facilities Area via the men and materials drift. Personnel and materials are transported underground from the Surface Facilities Area to the pit bottom by a combination of rail mounted drift winders and mobile vehicles.

3.6 Coal Handling, Processing and Transport

ROM coal produced at Myuna Colliery is transferred from the underground workings to the surface coal handling plant (CHP) via a number of underground conveyors. Coal is initially delivered to the ROM bin and then fed through a primary screen before being transported to a rotary breaker for initial breaking. From the rotary breaker, the coal travels through three feeders and three screens, into three crushers. Once the coal has travelled through the crushers, coal with a final product size of generally less than 40 millimetres is loaded into the final product bin. From the final product bin, coal is loaded onto the Origin Energy owned enclosed overland conveyor and delivered to the Eraring Power Station. Approval for Origin Energy's enclosed overland conveyor is provided by section 21 of the Eraring Power Station Act 1981.

In the event of break downs or servicing of the enclosed overland conveyor, CMPL temporarily stores coal in a dedicated stockpile area in the north of the Surface Facilities Area (as shown on **Figure 8**). Coal is recovered from the stockpile by front end loader, loaded onto trucks and dumped into a CHP reclaim hopper for transportation to Eraring Power Station by the enclosed overland conveyor as required.

3.7 Rejects Management

As Myuna Colliery does not wash ROM coal, there is no coal reject material produced on site. A negligible amount of waste rock from the CHP is transported from the waste bin to the Awaba Waste Management Facility for disposal.

3.8 Surface Infrastructure

The Myuna Colliery Surface Site is located on Wangi Point Road, near the township of Wangi Wangi. The primary items of existing approved infrastructure at the Myuna Colliery Surface Facilities Area are:

Mine Infrastructure:

- Men and materials portal;
- Conveyor drift portal;
- Drive houses;
- Up-cast ventilation shaft and fan-house;

- Downcast ventilation shaft;
- Road ballast and concrete bore holes with associated infrastructure;
- Power Factor Correction Banks;
- Diesel and Oil Tanks;
- Water storage tanks; and
- Emergency Coal Stockpile Area.

Coal Handling Plant:

- Breaker and crusher groups, feeders and coal storage bins (ROM bin and Final Product Bin); and
- Surface conveyor systems.

Workshop and administration infrastructure:

- Workshop, store and wash down facilities;
- Material yard and equipment/oil and gas stores;
- Materials reclaim area;
- Administration offices and bath house;
- Air compressors and associate infrastructure;
- Service bay;
- Hardstand areas, haul roads, car-parking areas and emergency heli-pad; and
- Fire station and associated fire fighting equipment.

Pollution control infrastructure:

- Wash down bay oil/water separator;
- Primary settlement tank (sump);
- Emergency Coal Stockpile Sediment Dam and pump-house;
- Dust suppression system at the CHP and coal stockpile area; and
- Hydrocarbon recycling depot.

Non-mine infrastructure, located at the Surface Facilities Area includes:

- Enclosed Overland Conveyor (Eraring Energy owned);
- Potable water supplies (Hunter Water Corporation) from Toronto and Wangi Wangi reservoirs;
- Overhead transmission lines (Energy Australia) (including 11kV and 33kV power supplies);

- EnergyAustralia 33kV substation;
- Telecommunications (Telstra) network cabling; and
- Hunter Water sewage system (Hunter Water Corporation).

Infrastructure at the Myuna Colliery Surface Facilities Area is shown on **Figure 8**.

Figure 7 – Myuna Colliery Subsidence Zones

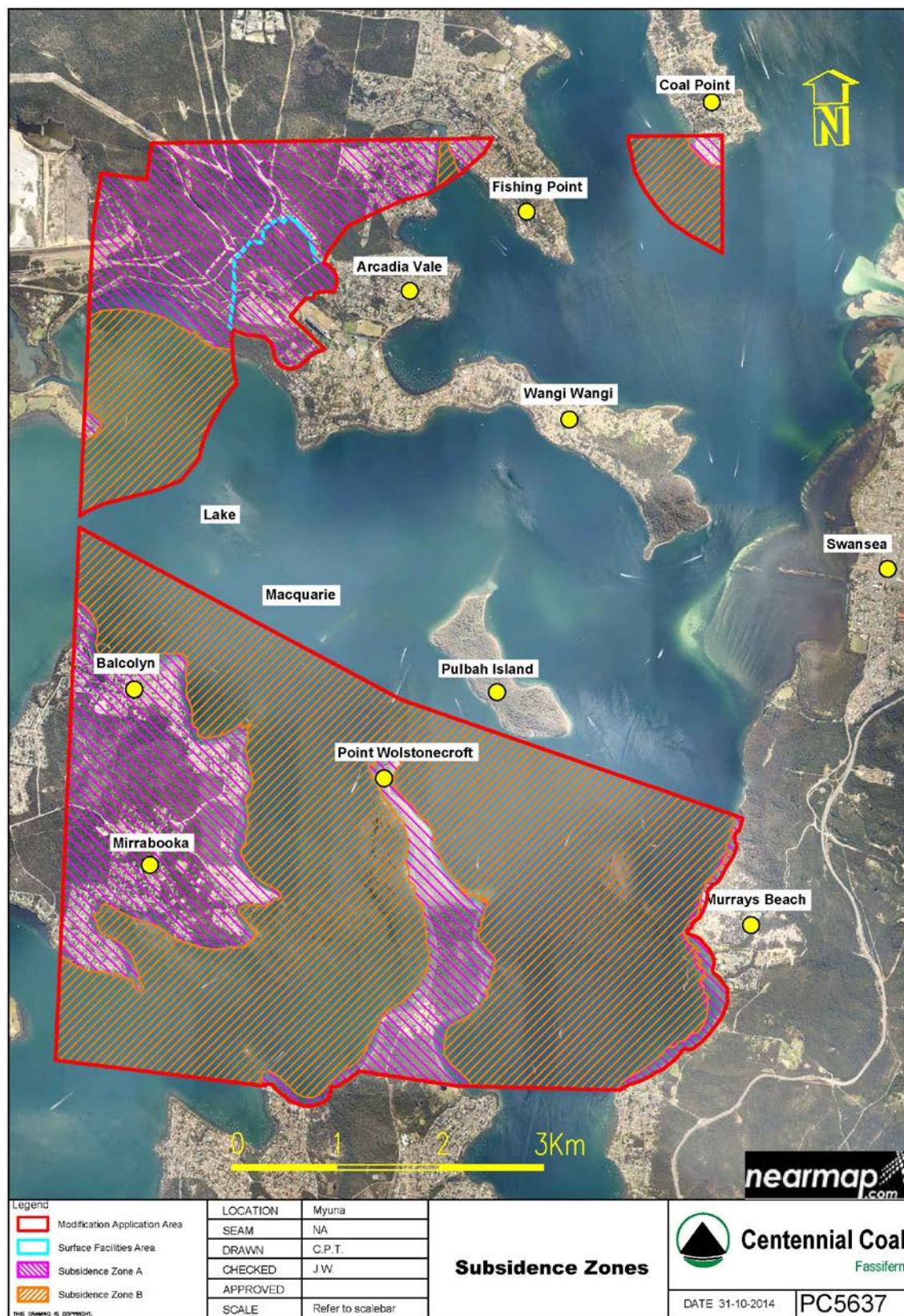
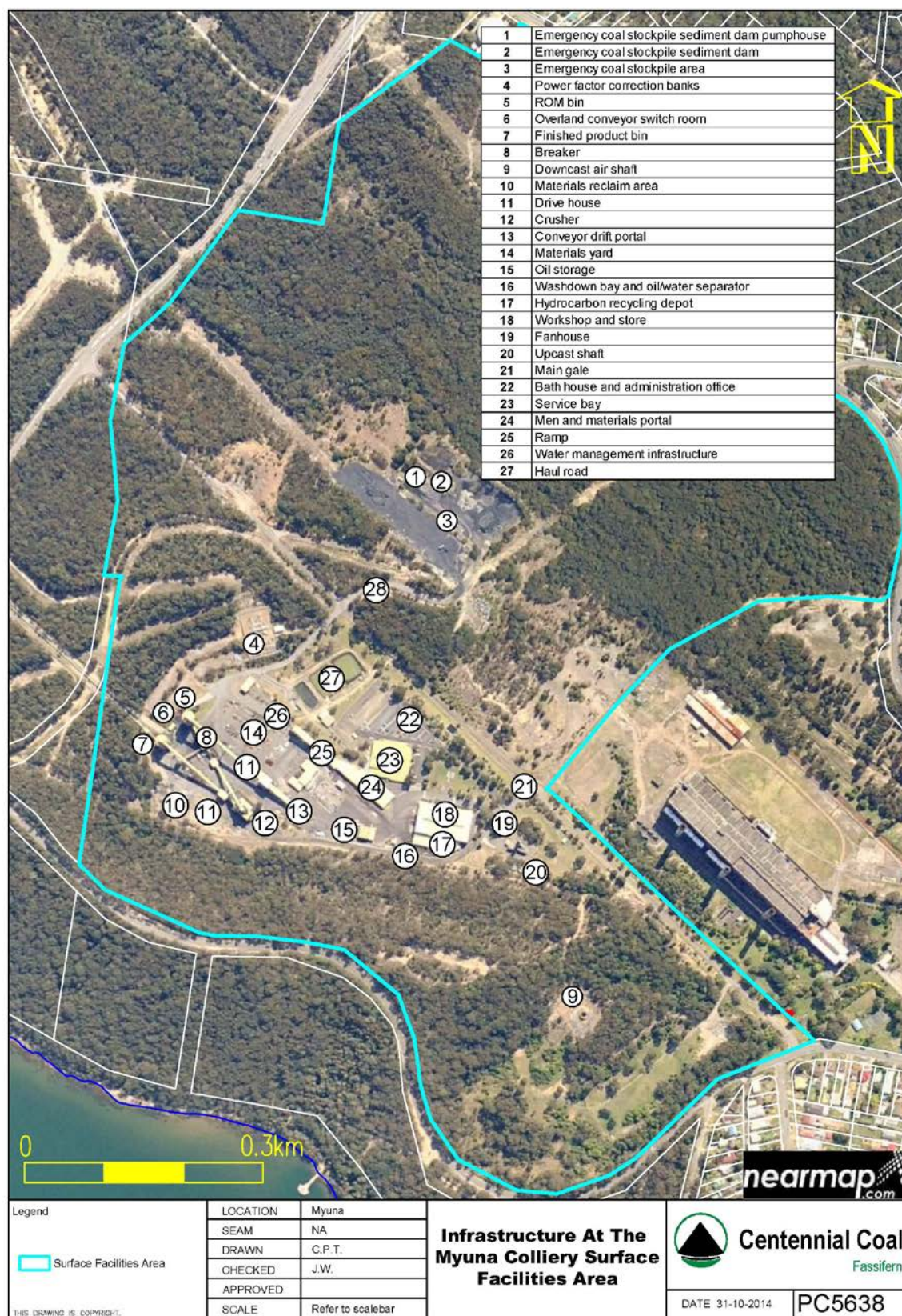


Figure 8 - Infrastructure at the Myuna Colliery Surface Facilities Area



3.9 Water Management

Water management at Myuna Colliery is undertaken in accordance with the approved Myuna Colliery Water Management Plan. The primary water management infrastructure at the Surface Facilities Area includes:

- CHP Dam which receives water from dirty water catchment areas;
- Mine Water Settling Ponds 2 and 3;
- Drive-in primary settlement tank;
- Decanting pump to underground
- Licensed Discharge Point – LDP B located at the outlet of Mine Water Settling Pond 3;
- Licensed Discharge Point - LDP A located at the weir of the Emergency Stockpile Sediment Dam;
- Emergency Coal Stockpile Sediment Dam.
- First flush settlement tank; and
- All drains associated with water management on site.

Water management at the Surface Facilities Area is primarily achieved through the separation of clean and dirty water.

3.9.1 Clean Water Management

Clean water management - includes diversion of external catchment runoff through a series of clean water diversions which direct the flow of surface water from clean catchments away from dirty catchment areas, and the management of clean surfaces within the surface facilities area. Clean surfaces managed within the Surface Facilities Area include:

- Roof runoff from the administration, bathhouse and workshop buildings, which is collected through downpipes and directed to the piped stormwater network, into the first flush settlement tank, eventually discharging into an open channel which drains to Wangi Creek.
- Runoff from several clean hardstand areas including the car park and materials yard. To maintain these hardstand areas as clean catchments, regular sweeping is undertaken and these areas are also regularly inspected to ensure that they remain clean. This runoff is discharged through the first flush settlement tank eventually discharging into an open channel which drains to Wangi Creek.
- External catchment runoff from areas surrounding the Surface Facilities Area.

3.9.2 Dirty Water Management

Dirty water management - includes the capture of water from disturbed surfaces and a series of dirty water diversions which direct flow of dirty water to the dirty water management system. Dirty water sources include:

- Runoff from the CHP and storage yard is directed through a series of open drains, diversions, collection sumps and pipes to the primary settlement tank, which then discharges into the CHP Dam.
- Runoff captured from the Emergency Coal Stockpile Area within the Emergency Coal Stockpile Sediment Dam. Water levels in the Emergency Coal Stockpile Sediment Dam are monitored, and water is transferred to CHP dam as required through bi-directional pipeline and pumping mechanism. In the event that the capacity of the Emergency Coal Stockpile Sediment Dam is exceeded, ponding extends into the broader Emergency Coal Stockpile Area. There is also a discharge point (that contributes to Wangi Creek) from this dam in the event of an extreme rainfall event (in excess of 80 millimetres in 24 hours), accompanied by a failure of the pumping mechanism.
- Runoff from the washdown bay is directed to the oil/water separator and tank. Water from the oil/water separator is pumped to sewer in accordance with a Trade Waste Permit from Hunter Water Corporation.
- Dirty water in the CHP Dam is pumped to the underground storage for settlement. The CHP Dam is maintained at a minimum level.

3.9.3 Water Discharge

EPL 366 permits the discharge of water from the Myuna Colliery Surface Site via two licensed discharge points (LDP A and LDP B) into Wangi Creek, which reports to Lake Macquarie. EPL 366 allows for the discharge of 13 megalitres (ML) per day via LDP B. Discharges via LDP A are rainfall based and not limited by EPL 366.

The volume of water discharged from LDP B is monitored continuously. The volume limit for LDP B is 13 ML per day. A flow meter was installed at LDP B in July 2013. The maximum discharge through LDP B in a day for the previous 12 months to date was 11.47 ML. During the 12 month period the mine water discharge has averaged 4.66 ML per day. There is no volumetric limit for LDP A.

3.9.4 Underground Water Management System

Within the current area of operations at Myuna Colliery, groundwater seeps into the underground workings and forms the mine water make, which is stored in four underground storage areas:

- Dam 324 (Wallarah Dam)
- Dam 642 (Great Northern Dam)
- Dam 421 (Great Northern)
- Dam 720 (Old Fassifern Dam)

Mine water make contained in these underground storages is allowed to settle in order to remove coal fines, prior to being pumped to Settling Ponds 2 and 3 at the Surface Facilities Area and is ultimately discharged to Wangi Creek through LDP B.

3.9.5 Other Water Management Infrastructure

Other water management infrastructure located at the Surface Facilities Area includes:

- Monitoring equipment for discharges;
- Dewatering bores; and
- Stormwater infrastructure including drains.
- Sewerage connections and drainage on site.

With the exception of the trade waste and sewage, all other water systems deliver water to Wangi Creek through the two LDPs. Wangi Creek discharges into Lake Macquarie at Wangi Bay.

3.10 Waste Management

3.10.1 Production Waste

As Myuna Colliery does not wash ROM coal, there is no coal reject material produced on site. A negligible amount of waste rock from the CHP is stored on site.

3.10.2 General Waste

General refuse and non-recyclable materials are separated and stored within dedicated waste bins located adjacent to the various site buildings. Waste sorting is undertaken by contractors on-site and is monitored via weekly environmental inspections.

All general wastes and routine maintenance consumables from the daily servicing of equipment (for example, air filters) are collected on a regular basis by an appropriately licensed contractor for off-site disposal within a waste facility approved to accept such waste.

Recyclable material is also collected by licensed contractors for recycling on an irregular (as needs) basis. Metals are collected and stored in surface bunkers and collected by a licensed contractor.

3.10.3 Waste Oil and Grease

The generation of waste oils and grease is currently limited to the routine maintenance of plant and equipment. Waste oils are stored in the waste oil bin and greases are stored in drums within bunded areas at the diesel shed and wash down bay.

Oily water from the wash down bay, designated equipment storage area, and compressors is drained to the oil water separator.

Licensed contractors regularly service and maintain the separators and remove all waste hydrocarbons from the site for recycling and/or disposal at a registered waste facility.

3.10.4 Sewage

The Myuna Colliery Surface Facilities Area is connected to the Hunter Water Corporation sewage system for the disposal of sewage generated on site as per the Trade Waste Permit D-171027.

3.11 Post Mining Closure and Rehabilitation

Rehabilitation at Myuna Colliery is undertaken in accordance with the approved Myuna Colliery Mining Operation Plan, Rehabilitation Management Plan and the Environmental Assessment for PA 10_0080.

Rehabilitation of the surface facilities shall be completed to the satisfaction of the Executive Director - Mineral Resources.

3.12 Environmental Management

The Myuna Colliery Environmental Management System (EMS) has been developed and implemented in accordance with the *Centennial Coal Environmental Management System Framework* (2011) to comply with the environmental management expectations of Centennial's internal standards, regulatory authorities and the local community.

The EMS framework document and accompanying standards, procedures and plans are part of the mine management system. Compliance with the system's requirements is an expectation of all employees of CMPL.

3.12.1 EMS and Management Plans

As part of the EMS, a comprehensive set of environmental management plans has been developed and implemented at the Myuna Colliery. The implementation of these plans and the integration of the Centennial Coal Environmental Management System Framework (2011) demonstrates environmental due diligence. The plans are reviewed and updated, as scheduled or as necessary, to reflect operational changes and incorporate additional/amended requirements.

The existing management plans that have been developed for Myuna Colliery are listed in **Table 3**.

Table 3 - Environmental Management Plans

Reference	Title
MM-EMS-3-001	Water Management Plan
MM-EMS-3-002	Dust Management Plan
MM-EMS-3-003	Noise Management Plan
MM-EMS-3-004	Land Management Plan
MM-EMS-3-005	Bushfire Management Plan
MM-EMS-3-006	Hydrocarbon Management Plan

Reference	Title
MM-EMS-3-007	Waste Minimisation and Management Plan
MM-EMS-3-008	Weed and Pest Management Plan
MM-EMS-3-009	Hazardous Substances Management Plan
MM-EMS-3-010	Stakeholder Engagement Management Plan
MM-EMS-3-011	Pollution Incident Response Plan
HSMS-HMP-D-03	Hazardous Management Plan: Inrush Management Document
	Aboriginal Cultural Heritage Management Plan for Northern Holdings.
Country Energy	Myuna Colliery Energy Savings Action Plan 2006

3.12.2 Monitoring and Reporting

The environmental management plans are backed by an environmental monitoring network. The various monitoring sites for Myuna Colliery are shown on **Figure 9**. Monitoring comprises the following:

- Surface water quality monitoring;
- Groundwater monitoring;
- Sediment and erosion control structures and rehabilitation monitoring;
- Flora and fauna monitoring;
- Cultural heritage monitoring;
- Meteorological monitoring;
- Subsidence monitoring;
- Air quality monitoring; and
- Noise monitoring.

Monitoring results are reported monthly on Centennial's website and on an annual basis in the Annual Review.

Figure 9 – Myuna Colliery Monitoring Locations



4 PROPOSED MODIFICATION

4.1 Overview of Proposed Modification

CMPL are seeking to modify Project Approval 10_0080 pursuant to Section 75W of Part 3A of the EP&A Act to allow for:

- an increase in ROM coal extraction to up to 3 million tonnes per annum; and
- an increase in employment to up to 300 full time employees.

A comparison between currently approved operations and the modification is presented in **Table 4**.

Table 4 - Comparison of Approved and Proposed Operations

Aspect	Approved Operations	Proposed Modifications
Life of Mine	31 st December 2032	No change
Operational Hours	24 hours a day, seven days per week.	No change
Operational Employment	Up to 210 full-time personnel.	Increase in full time personnel to 300. An additional 90 full-time personnel.
Minining Areas	within the Project Approval Area and Development Consent mining area within the Wallarah, Great Northern, and Fassifern Coal Seams	No change
Mining Method	conventional underground bord and pillar mining methods within two Zones: Zone A – Long term stable mining systems generating up to 20 millimetres surface subsidence Zone B – Mining systems generating up to a maximum of 650 millimetres surface subsidence.	No change
Mining Production	Up to 2 Mtpa of ROM coal	Up to 3 Mtpa of ROM coal
Mine Access	Myuna Colliery Surface Site men and materials drift.	No change
Coal Handling, Processing and Transport	Rom coal transferred from the underground workings to the surface CHP via a number of underground conveyors CHP includes Breaker and crusher, feeders and coal storage bins (ROM bin and Final Product Bin) and surface conveyor systems Product coal transferred to Eraring Power Station via the Eraring Energy Owned	No change

Aspect	Approved Operations	Proposed Modifications
	overland conveyor Emergency coal stockpile utilised as required	
Rejects Management	No coal reject material produced on site. A negligible amount of waste rock from the CHP is stored on site.	No change
Surface Infrastructure	Myuna Colliery Surface Site	No change
Water Management	In accordance with the approved Myuna Colliery Water Management Plan	No change
Waste Management	Management systems in place for the various non-production waste streams, including general waste, maintenance consumables, waste oils and grease and sewage.	No change
Post Mining Closure and Rehabilitation	In accordance with the Myuna Colliery Mine Operations Plan.	No change
Environmental Management	Myuna Colliery EMS provides a framework under which environmental matters are managed at the Myuna Colliery.	No change

4.2 Life of Mine

The proposed modification will not increase the currently approved life of mine beyond 12 December 2032.

4.3 Operational Hours

Myuna Colliery will continue to be a 24 hour a day, seven day a week operation.

4.4 Operational Employment

The proposed modification will increase the number of full time employees at the Myuna Colliery from 210 to 300 personnel, an increase of 90 personnel.

4.5 Mining

4.5.1 Mining Area

Coal will continue to be recovered from the three seams (Wallaharah, Great Northern, and Fassifern) within the Modification Application Area.

4.5.2 Mining Method

There will be no change in the method of extraction or subsidence zones as described in **Section 3.5.2**.

4.5.3 Mining Production

The proposed modification will increase the volume of ROM coal produced at the Myuna Colliery from up to 2 Mtpa to up to 3 Mtpa in any calendar year.

4.5.4 Mine Access

There will be no change in men and materials access to the underground workings to that described in **Section 3.5.4**.

4.6 Coal Handling, Processing and Transport

There will be no change to coal handling processing or transport methods to that described in **Section 3.6**. The underground conveyor delivery system has a capacity of 2100 tonnes per hour. In order to extract and process the additional coal to the surface, some of the underground conveyor belts will increase slightly in speed (i.e. from 3.2 m/s to 3.8 m/s) These changes are extremely minor and will have no influence on the environmental outcomes as detailed in this EIS.

Additionally, in order to process the additional coal, the rotary breaker will operate for a longer period of time that it currently does. The Myuna Extension of Mining Environmental Impact Assessment (AECOM, 2011) considered the rotary breaker operating 24/7 and as such the impact of the rotary breaker operating for additional time will be within the limits of what has previously been assessed and approved.

4.7 Rejects Management

Waste rock from the CHP will continue to be transported to the Awaba Waste Management Facility for disposal.

4.8 Surface Infrastructure

No additional infrastructure is required to support the proposed modification. Infrastructure described in **Section 3.8** will continue to be utilised for the life of the operation.

4.9 Water Management

There will be no change to water management methods to that described in **Section 3.9**. No increases in EPL discharge limits are required.

4.10 Waste Management

There will be no change to the management of waste on site to that described in **Section 3.10**.

4.11 Environmental Management

There will be no changes to the sites EMS as a result of the proposed modification. Monitoring and reporting will continue to be undertaken in accordance with approved management plans and licence requirements.

5 REGULATORY FRAMEWORK

The proposed modification will be subject to the legislative requirements of the Commonwealth and State, as well as relevant local and regional planning strategies. This section describes the approval pathway for the proposed modification, as well as outlining the various legislative requirements.

5.1 Commonwealth Legislation

5.1.1 Environment Protection and Biodiversity Conservation Act 1999

The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) is administered by the Commonwealth Department of the Environment (DotE) and provides a legal framework to protect and manage nationally important flora, fauna, ecological communities, water resources and heritage places defined as matters of national environmental significance (MNES). An action that “has, will have or is likely to have a significant impact on a matter of National Environmental Significance” may not be undertaken without prior approval from the Commonwealth Minister, as provided under Part 9 of the EPBC Act. Approval under the EPBC Act is also required where actions are proposed on, or will affect, Commonwealth land and its environment.

The Myuna Colliery Extension of Mining Project was referred to the DotE in 2011. On 8 June 2011, the Myuna Colliery Extension of Mining Project was determined not to be a controlled action. The proposed modification will not have any significant impact on MNES or water resources as listed in the EPBC Act beyond those previously assessed and approved however an EPBC variation will be prepared and submitted to DotE.

5.1.2 Native Title Act 1993

The Native Title Act 1993 recognises that Aboriginal people have rights and interests to land and waters which derives from their traditional laws and customs. Native title may be recognised in places where Indigenous people continue to follow their traditional laws and customs and have maintained a link with their traditional country. It can be negotiated through a Native Title Claim, an Indigenous Land Use Agreement (ILUA) or future act agreements.

An ILUA is an agreement between a native title group and other parties who use or manage the land and waters. The ILUA process allows for negotiation between indigenous groups and other parties over the use and management of land and water resources, and the ability to establish a formal agreement. An ILUA is binding once it has been registered on the Native Title Tribunal's Register of Indigenous Land Use Agreements.

A portion of lands within the Modification Application Area is subject to an ILUA that was entered into on 28 May 1999 by the Wonnarua people (Wonnarua Nation Aboriginal Corporation) and Powercoal Pty Ltd (since acquired by Centennial). As such, Centennial is bound by the terms of the ILUA, which are set out in the Master Deed, in the use and management of the subject land. Clause 7 of the Master Deed outlines Centennial's obligations, including provisions for compliance with an Aboriginal Heritage Protection Protocol (Clause 7.2 and Schedule 5).

The Deed is subject to a confidentiality clause and, as such, detailed commentary regarding the ILUA is not provided in this EA.

5.1.3 National Greenhouse and Energy Reporting Act 2007

The National Greenhouse and Energy Reporting Act 2007 (NGER Act) provides a single national framework for the reporting and dissemination of information about the greenhouse gas (GHG) emissions, GHG projects, and energy use and production of corporations. It makes registration and reporting mandatory for corporations whose energy production, energy use or GHG emissions meet specified thresholds.

Centennial reports emissions from the corporation, in accordance with NGER Act, on an annual basis, which includes emissions from the Myuna Colliery.

5.2 NSW State Legislation

5.2.1 Environmental Planning and Assessment Act 1979

Myuna Colliery operates under:

- Development Consent (SH 110/148) issued by Lake Macquarie City Council Council on 15 December 1977) under the *Local Government Act 1919*, which carries the same weight as a development consent under Part 4 of the EP&A Act.
- Project Approval 10_0080 issued by the Department of Planning and Environment May 2012 under Part 3A of the EP&A Act.

The development assessment and approval system in NSW is set out in Parts 3A, 4 and 5 of the EP&A Act. The (then) Minister for Planning and Infrastructure granted Project Approval PA 10_0080 under Part 3A of the EP&A Act on 18 January 2012.

CMPL proposes to modify PA 10_0080 pursuant to the provisions of Section 75W of Part 3A of the EP&A Act. Although Part 3A was repealed on 1 October 2011, project applications lodged prior and well advanced in the assessment process remained in the system as transitional Part 3A projects.

5.2.2 Mining Act 1992

The Mining Act makes provision for granting mining authorities, leases and licences which are required for the prospecting and mining of minerals and coal. The Mining Act also makes provision for the protection of the environment in relation to mining activities, including rehabilitation of areas subject to mining activities.

Myuna Colliery currently operates under ML 1370, CCL 762, and MPL 334 issued under the Mining Act. The conditions of ML 1370 and CCL 762 restrict mining under the 'High Water Level Subsidence Control Zone'; specifies the requirements for mining under 'marginal zones'; limits the type of operations within specified areas; and sets various depth restrictions across the lease areas. The leases specify resource recovery and mine working requirements; and include general conditions relating to rehabilitation and environmental management. The current leases also require the preparation of an annual exploration report as well as an AEMR.

No new mining leases are required to support the proposed modification.

5.2.3 Protection of the Environment Operations Act 1997

The Protection of the Environment Operations Act 1997 (POEO Act) is administered by the NSW Environment Protection Authority (EPA), which is an independent statutory authority and the primary environmental regulator for NSW. The objectives of the POEO Act are to protect, restore and enhance the quality of the environment. Some of the mechanisms that can be applied under the POEO Act to achieve these objectives include reduction of pollution at source and monitoring and reporting of environmental quality. The POEO Act regulates and requires licensing for environmental protection, including for waste generation and disposal and for water, air, land and noise pollution. Under the POEO Act, an EPL is required for premises at which a 'scheduled activity' is conducted.

Schedule 1 of the POEO Act lists activities that are scheduled activities for the purposes of the Act. EPL 366 regulates Myuna Colliery based on a maximum coal production of 2 Mtpa. A variation to EPL 366 will be sought to incorporate the increase in maximum coal production following approval of the proposed modification.

EPL 366 also includes relevant licensed discharge information. Licenced discharge information for the Myuna Colliery is provided in **Table 5**.

Table 5 - Myuna Colliery Licenced Discharge Points

Licence Number	EPA ID	Discharge Point	Discharge Point Name	Monitoring Requirements		Licenced Discharge Limit	Creek catchment
				Water quality	Volume		
366	9	Y	LDP B	O&G; pH; TSS	Y	13 ML/day	Wangi Creek
	10	Y	LDP A	O&G; pH; TSS	N	No limit specified	Wangi Creek

5.2.4 Mine Subsidence Compensation Act 1961

The Mine Subsidence Compensation Act 1961 (MSC Act) establishes a scheme for the payment of compensation for damage sustained to surface improvements by subsidence resulting from the mining of coal or shale. CMPL pays a levy under the MSC Act.

Section 15 of the MSC Act makes provision for the establishment of mine subsidence districts and requires that an approval is given by the Mine Subsidence Board for the alteration or erection of improvements or the subdivision of land within a proclaimed Mine Subsidence District. The Modification Application Area lies within the West Lake and Swansea North Entrance Mine Subsidence Districts.

Under the MSC Act, the Mine Subsidence Board sets subdivision, building, and construction guidelines, which are designed to ensure those residences and other structures, will tolerate the expected levels of subsidence in an area. Construction guidelines vary from area to area depending on the coal mining activity and the expected amount of subsidence.

5.2.5 Dams Safety Act 1978

A portion of the Modification Application Area falls within the Notification Area for the Eraring Ash Dam. The Dam Safety Committee regulates mining within the Notification Area under the Dams Safety Act 1978 and the Mining Act 1992.

5.2.6 Water Management Act 2000

The Water Management Act 2000 (WM Act) is progressively being implemented throughout NSW to manage water resources, superseding the Water Act 1912. The aim of the WM Act is to ensure that water resources are conserved and properly managed for sustainable use benefiting both present and future generations. It is also intended to provide formal means for the protection and enhancement of the environmental qualities of waterways and their in-stream uses as well as to provide for protection of catchment conditions. Fresh water sources throughout NSW are managed via Water Sharing Plans (WSPs) under the WM Act. Key rules within the WSPs specify when licence holders can access water and how water can be traded.

An amendment to the WM Act (Section 60I) came into effect on 1 March 2013. This amendment provides that it is an offence for a person without an access licence to take, remove or divert water from a water source or relocate water from one part of an aquifer to another part of an aquifer in the course of carrying out a mining activity. Various activities are captured by the provisions of the amendment including mining, mineral exploration and petroleum exploration.

The alluvial water sources and surface water sources within the Modification Application Area are covered under the WSP for the Hunter Unregulated and Alluvial Water Sources (HUA WSP). This WSP commenced in August 2009 and regulates the interception and extraction of surface water and alluvium within the defined WSP area.

The HUA WSP is categorised into four extraction management units and further broken down into water sources. The area covered by the WSP includes 39 surface water and alluvial groundwater sources.

The Myuna Colliery surface facilities area is located within the North Lake Macquarie water source.

5.2.7 Water Act 1912

CMPL has applied for licences under the Water Act 1912 from the NSW Office of Water (NoW) for underground dewatering works which are carried out on site for the current mining operations. These licences are currently before NoW.

5.2.8 National Parks and Wildlife Act 1994

The National Parks and Wildlife Act 1974 (NP&W Act) provides for the establishment, care, control, and management of national parks, historic sites, nature reserves, State conservation areas, Aboriginal areas, and State game reserves. The Modification Application Area encompasses parts of Lake Macquarie State Conservation Area.

The NP&W Act also provides for the protection of Aboriginal objects and the protection of native flora and fauna. Under section 75U(1)(d) of the EP&A Act, and in relation to Aboriginal heritage, a permit under

section 87 or consent under section 90 of the NP&W Act is not required for a project approved under Part 3A of the EP&A Act.

5.2.9 Heritage Act 1977

The purpose of the Heritage Act 1977 (Heritage Act) is to protect and conserve non-indigenous cultural heritage, including scheduled heritage items, sites, and relics. The Heritage Act is administered by the NSW Heritage Office within DP&E.

The Heritage Act makes provision for a place, building, work, relic, moveable object, precinct, or land to be listed on the State Heritage Register. As the proposed modification falls under Part 3A of the EP&A Act it is exempt from requirements for approvals required under the Heritage Act.

5.2.10 Threatened Species Conservation Act 1995

The Threatened Species Conservation Act 1995 (TSC Act) provides for the conservation of threatened species, populations, and ecological communities of animals and plants. This conservation is achieved, in part, by protecting critical habitat of threatened species, populations and ecological communities; and eliminating or managing certain processes that threaten the survival or evolutionary development of threatened species, populations and ecological communities. The TSC Act also provides a framework to ensure that the impact of any action affecting threatened species is assessed.

The proposed modification will not impact on any endangered species, populations, or ecological communities listed under the TSC Act.

5.3 Environmental Planning Instruments

5.3.1 State Environmental Planning Policies

State Environmental Planning Policy (State and Regional Development) 2011

This State Environmental Planning Policy (SEPP) came into effect upon the repeal of Part 3A of the EP&A Act and identifies development to which the State significant development and approval process under Part 4 of the Act apply. However, pursuant to Clause 24 of the SEPP, the transitional Part 3A provisions outlined in Schedule 6A of the EP&A Act continue to apply. The provisions of this SEPP do not apply to the proposed modification as it is to be considered under the savings provisions of the former Part 3A provisions of the EP&A.

State Environmental Planning Policy (Mining, Petroleum Production & Extractive Industries) 2007

The State Environmental Planning Policy (Mining, Petroleum Production & Extractive Industries) 2007 (Mining SEPP) regulates the permissibility of mining and related development and specifies matters that must be considered in assessing mining developments requiring consent under Part 4 of the EP&A Act.

Clauses 12 to 17 (inclusive) require consideration to be given to the compatibility of projects with other surrounding land uses, including the existing and potential extraction of minerals, natural resource management and environmental management, resource recovery, transportation and rehabilitation.

Clause 5 of the Mining SEPP addresses its relationship with other environmental planning instruments, and states that if the Mining SEPP is inconsistent with any other environmental planning instrument, the Mining SEPP prevails to the extent of the inconsistency, with the exception of SEPP (State and Regional Development), SEPP 14 Coastal Wetlands and SEPP 26 Littoral Rainforests. Irrespective of the provisions of Lake Macquarie Local Environment Plan (LEP) 2014 or Wyong LEP 2013, Myuna Colliery and the proposed modification is permissible with consent.

The proposed modification is minor and will be consistent with the aims and objectives of the SEPP.

State Environmental Planning Policy No. 44 – Koala Habitat Protection

This SEPP restricts the granting of development consent on land identified as core koala habitat without preparation of a Plan of Management. The proposed modification will not impact on any area of potential koala habitat, as no additional surface disturbance is proposed.

State Environmental Planning Policy (Infrastructure) 2007

This SEPP aims to facilitate the effective delivery of infrastructure across NSW. Clause 45 of the SEPP provides that for a development application in respect of development carried out:

- Within or immediately adjacent to an easement for electricity purposes (whether or not the electricity infrastructure exists), or
- Within 5 metres of an exposed overhead electricity power line.

The consent authority must give written notice to the electricity supply authority for the area and invite comments about potential safety risks (and take into consideration any response to that notice received within 21 days after the notice is given).

This proposed modification will have no impact on any electricity supply infrastructure.

5.3.2 Local Environment Plans

Lake Macquarie Local Environmental Plan (LEP) 2014

Lake Macquarie LEP 2014 is the principal Environmental Planning Instrument (EPI) applying to the Lake Macquarie LGA. The existing surface facilities at Myuna are situated on land zoned SP1 Special Activities and E2 Environmental Conservation.

The Modification Application Area also encompasses land predominantly zoned W1 Natural Waterways, E2 Environmental Conservation, R2 Low Density Residential and RE1 Public Recreation. Mining is not listed as being permissible with or without consent within the Lake Macquarie LEP and, therefore, mining operations at the Myuna Colliery would be prohibited under these instruments. However, this does not affect permissibility due to the provisions of the Mining SEPP.

Wyong Local Environmental Plan 1991

A small section in the south of the Modification Application Area, at Point Wolstoncroft, is located within the Wyong LGA, and is zoned E1 National Parks and Nature Reserves under the Wyong LEP 2013. Mining is not listed as being permissible with or without consent within the Wyong LEP and, therefore, mining operations at the Myuna Colliery would be prohibited under these instruments. However, this does not affect permissibility due to the provisions of the Mining SEPP.

6 IDENTIFICATION OF KEY ENVIRONMENTAL ISSUES

6.1 Introduction and Objectives

The Myuna Colliery utilises a risk assessment process to identify environmental, safety and business risks to its operation. The compilation of this EA was undertaken through a risk-based and consultative approach. The key Modification-related issues warranting detailed investigation and discussion were identified through:

- The existing environmental context of the Modification Application Area and surrounding locality (see **Section 2**);
- The scope of the proposed modification;
- The legislative framework applicable to the proposed modification (see **Section 5**); and
- The outcomes of consultation undertaken with the DP&E (see **Section 7** and **Appendix A**).

The above risk-based approach enabled an identification of the potential environmental impacts that would require further assessment as part of this EA.

6.2 Environmental Considerations

The environmental considerations that would require further assessment were identified as:

- Traffic;
- Air Quality;
- Noise;
- Groundwater; and
- Socio Economic.

7 STAKEHOLDER CONSULTATION

7.1 Government Agency Consultation

7.1.1 NSW Planning and Environment

CMPL advised DP&E in writing on 4 August 2014 of their intention to seek a modification to PA 10_0080 to allow for the proposed activities as detailed in this EA. The letter included an overview of the proposed modification and identified environmental aspects that would be considered as part of the preparation of an EA.

In an email date 8 August 2014, DP&E responded to CMPL outlining DP&E's requirements to be addressed in the EA. These were:

- A full description of the proposed modification and a comparison to existing approved operations at the mine, setting out the manner in which the mine's existing infrastructure would be able to accommodate the proposed increased coal production and workforce;
- A consideration of the statutory framework for the proposed modification including justification of the use of Section 75W;
- A description of the consultation undertaken by the company with government agencies and the local community during the preparation of the EA;
- A full description of the potential impacts of the proposal and any measures that the company would undertake (where relevant) to avoid, mitigate or offset these impacts, including:
- a Traffic Impact Assessment addressing increased traffic generated by the increased number of employees and any additional heavy vehicle movements associated with the proposal;
- a revised Air Quality Impact Assessment that models the effects of the increase in coal movements on the site and any relevant changes to surface activities or changes to mine ventilation volumes;
- a desk top review of existing noise modelling;
- a desk top review of existing groundwater studies;
- a review of impacts of groundwater discharges to local water ways, and in particular, Lake Macquarie;
- an assessment of socio-economic impacts attributable to the proposed increase coal production and employment at the mine.

A copy of the email from the DP&E is provided in **Appendix A**.

7.2 Community Consultation

7.2.1 Myuna Colliery Community Consultative Committee

The Myuna Colliery Community Consultative Committee (CCC) comprises representatives from local government and the community, and is independently chaired. The CCC provides a forum for open discussion between representatives of Centennial, the community, Lake Macquarie City Council and other stakeholders on issues directly relating to the mine's operations, environmental performance and

community relations, and keeps the community informed on these matters. The CCC meets every two to three months. The next CCC is scheduled for December 2014. This modification will be discussed at the next CCC.

8 ASSESSMENT AND MANAGEMENT OF KEY ENVIRONMENTAL ISSUES

8.1 Traffic

A Traffic Impact Assessment has been prepared by Intersect Traffic to support the proposed modification and has been provided as **Appendix B** to this EA.

8.1.1 Existing Environment

Myuna Colliery is bounded by Wangi Road, Summerhill Drive and Donnelly Road. Myuna Colliery is accessed by a private road (Wangi Point Road) which intersects with Summerhill Drive. Summerhill Drive connects to Donnelly Drive (via The Promenade) and Wangi Road to the northwest. The Myuna Surface Facilities Area is accessed off Summerhill Drive to the north-west of the township of Wangi Wangi.

Summerhill Drive

Summerhill Drive is a two way two lane urban road from Dobell Drive to Wangi Point Road and a two way two lane rural road from Wangi Point Road to Wangi Road that connects the Wangi Wangi area to Wangi Road. Under a functional road hierarchy this road performs as a minor collector road in that it collects traffic from a number of tributary local access roads and distributes traffic to the main arterial road network.

As a local road Summerhill Drive is under the care and control of Lake Macquarie City Council. Summerhill Drive is speed zoned 50 km/h between Dobell Drive and Wangi Point Road and 80 km/h between Wangi Point Road and Wangi Road.

Wangi Point Road - Myuna Colliery Surface Facilities Area Access

The existing Myuna Mine Access is via Wangi Point Road and connects to Summerhill Drive. Wangi Point Road is a private road under the care and control of CMPL.

The intersection with Summerhill Drive is constructed as an urban intersection with Give Way conditions applying to the Wangi Point Road leg. A 50 km/h speed limit applies from Summerhill Drive to the main entry to the Myuna Colliery. A 20 km/h speed limit applies within the Myuna Colliery Surface Facilities Area.

Donnelly Road

Donnelly Road is a local collector road that provides a secondary connection from Myuna Colliery to Wangi Road via Dobell Drive and then to Wangi Road. In the vicinity of Dobell Drive it is a two way two lane road with varying speed limits between 50 km/h and 70 km/h.

Wangi Road

Wangi Road connects the townships of Dora Creek to the south-west and Toronto to the north-east. It is a two way two lane road in each direction for the majority of its length. To the north-east of Summerhill Drive the northbound and southbound lanes of Wangi Road alternate between one and two lanes in each direction. Wangi Road has a speed limit of 90 km/h and is a State Road under the care and control of the Roads and Maritime Service (RMS).

Myuna Colliery Shift Times

Shifts at the Myuna Colliery generally operate between the following hours:

- Day shift - 6.30am to 2.30pm;
- Afternoon shift - 2.30pm to 10.30pm; and
- Night shift - 10.30pm to 6.30am.

8.1.2 Impact Assessment

As a result of the proposed increase in employees there will be an associated potential impact on the adjacent road network

The external road network potentially impacted by the proposed modification will be:

- Summerhill Drive from Wangi Road to Dobell Drive;
- Dobell Drive from Summerhill Drive to Donnelly Road;
- Donnelly Road from Dobell Drive to Wangi Road; and
- Wangi Road from Donnelly Road to Summerhill Drive.

The intersections on the surrounding road network that will be potentially impacted on by additional traffic are:

- Summerhill Drive / Wangi Point Road (access to Myuna Colliery);
- Summerhill Drive / Wangi Road; and
- Donnelly Road / Wangi Road.

Table 6 below provides the proposed distribution for each shift.

Table 6 - Proposed Employees per shift

Shift Time	Number of Employees
Day Shift	150
Afternoon Shift	80
Night Shift	70
Total	300

The peak traffic generating periods for the Myuna Colliery operations are likely to occur when day shift changes to afternoon shift at 2.30pm. This period is also likely to coincide with relatively busy periods on the local road network.

Traffic and Transport

As part of the Traffic Impact Assessment, Intersect Traffic completed three (3) peak hour movement surveys between 2 pm and 3.30 pm at the following times and locations to permit analysis using the Sidra Intersection model:

- 24/6/14 – Summerhill Drive / Wangi Point Road intersection;
- 14/7/14 – Wangi Road / Donnelly Road; and
- 15/7/14 – Wangi Road / Summerhill Drive

Table 7 summaries the existing traffic for each leg at each intersection and provides a total volume for each road.

Table 7 - Existing PM Traffic Volume Data (Intersect)

Intersection	Approach	Volume (vtph)	Total (vtph)
Summerhill Dr / Wangi Point Rd	Summerhill Dr west	187	
	Summerhill Dr east	151	338
	Wangi Point Rd	82	82
Wangi Rd / Donnelly Road	Wangi Rd west	943	
	Wangi Rd east	672	1615
	Donnelly Rd	315	315
Wangi Rd / Summerhill Dr	Wangi Rd west	404	
	Wangi Rd east	395	799
	Summerhill Rd	111	111

The capacity of urban and rural roads is generally governed by the capacity of intersections on the road network however Table 4.5 of the RMS' Guide to Traffic Generating Developments gives some guidance on the mid-block capacity and expected levels of service (LOS) on rural roads.

Assuming a 100 km/h design speed, 10 % heavy vehicles and rolling terrain the likely LOS thresholds on the rural road network being assessed would be as shown in **Table 8** below.

Table 8 - Likely Level of Service thresholds

Level of Service	Traffic volume (vph)
A	0
B	360
C	650

Level of Service	Traffic volume (vph)
D	970
E	1720

Given current traffic volumes (**Table 7**) it can be seen that the local road network currently operates with the following Levels of Service.

Table 9 - Current Estimated Levels of Service – local road network

Road	Level of Service
Summerhill Dr	A
Donnelly Rd	A

To assess the impacts of the proposed additional employee numbers on the local road network, Sidra modelling has been carried out using the level of service (delay) model adopted by the RMS in NSW. Average delay is used to determine the level of service (LOS) based on the following table sourced from the RMS' Guide to Traffic Generating Developments. For assessment purposes a LOS D or higher is considered satisfactory intersection operation. The results of this modelling are shown in the following tables.

Summerhill Drive / Wangi Point Road Intersection

Table 10 - Summerhill Drive / Wangi Point Road - Sidra Model Movement Summary

Scenario	Average Delay	Level of Service
Existing	2.4 s	A
With Development	3.2 s	A

The intersection operates well within capacity with a LOS of A with little or no delay for motorists. Therefore the additional employee traffic does not adversely impact on this intersection.

Wangi Road / Summerhill Drive Intersection

Table 11 - Wangi Road / Summerhill Drive - Sidra Model Movement Summary

Scenario	Average Delay	Level of Service
Existing	1.8 s	A

With Development	2.3 s	A
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The intersection operates well within capacity with a LOS of A with little or no delay for motorists. Therefore the additional employee traffic does not adversely impact on this intersection.

Wangi Road / Donnelly Road Intersection

Table 12 - Wangi Road / Donnelly Road - Sidra Model Movement Summary Sheets

Scenario	Average Delay	Level of Service
Existing	2.3 s	A
With Development	2.4 s	A

The intersection operates well within capacity with a LOS of A with little or no delay for motorists. Therefore the additional employee traffic does not adversely impact on this intersection.

Road Safety

The road network impacted on by the proposed modification is considered to be suitable to carry the increase in traffic volumes. There is sufficient sight distance at the intersections of Summerhill Drive / Wangi Point Road and Donnelly Road / Wangi Road to ensure there are no road safety impacts as a result of additional traffic generated. Sight distance to the north at the intersection of Summerhill Drive / Wangi Road is restricted under the existing situation, due to the crest of the hill at this location. However as the amount of additional traffic generated by this proposed modification is relatively minor compared to existing traffic volumes at the intersection this issue is not considered to be significant to the approval of the proposed modification.

On-site Car Parking

The traffic counts carried out at the Myuna Colliery Surface Facilities Area entrance has identified that the additional peak hour traffic volume generated by the proposed modification to increase output from the mine is of the order of 60 vehicles per hour at the afternoon change of shifts. It would be reasonable to assume that this would correlate to a peak on-site parking demand of 60 vehicles. The existing on-site peak parking demand is estimated to be in the order of 170 vehicles based on the day and afternoon shift numbers. Therefore the proposed modification to increase the output from Myuna Colliery is likely to increase the on-site car parking demand to 230 vehicles.

There is a significant on-site car parking area at the Myuna Colliery Surface Site. The estimated number of on-site car parks is in the order of 207 therefore this calculation shows that the proposed modification to increase production from the Myuna Colliery could lead to a small shortage of on-site car parking. It should be noted car-pooling and slight variations in arrival and departure times for employees could reduce the car parking deficiency. It should also be noted the peak parking demand period is short coinciding with the arrival of the afternoon shift prior to the departure of the day shift from the site and will only occur when employee levels are reaching the proposed maximum.

However the Myuna Colliery Surface Facilities Area is large and there are a number of areas that could be utilised for overflow car parking should the existing on-site car parking be deficient for the small period during the shift changeover. These additional overflow areas include around the ventilation fan which provides up to 25 additional car parks and along an existing internal road network. Both these areas are sealed and no additional vegetation clearing would be required to utilise these areas as overflow parking. These areas have been highlighted in the Traffic Impact Assessment provided as **Appendix B** to this Environmental Assessment. It is considered the proposed modification will not result in any on-street car parking occurring in the vicinity of the Myuna Colliery that would impact on the safety and efficiency of the public road network.

Alternate Transport Modes

The Myuna Colliery Surface Facilities Area is currently not serviced by public transport. The nearest public bus service provided by Hunter valley Buses operates as Route 275 and 276 on Dobell Drive which is approximately 400 metres from the intersection of Wangi Point Road and Summerhill Drive intersection. Similarly there are no rail services within convenient walking distance to the site.

Given that the additional employee numbers per shift is not high and that the local road network is not nearing capacity thresholds the need to encourage public transport usage in this location is not critical. Therefore it is considered there is no real nexus to require the extension of public transport services to the site.

There are no on or off road pedestrian and cycle way facilities in the vicinity of the Myuna Colliery Surface Facilities Area. This means pedestrians and cyclists accessing the site would need to share the travel lanes on the local road network. It was also noted during the recent traffic counts that there was little if any pedestrian and bicycle traffic to and from the site. As there is little existing demand for these facilities and there is likely to be little if any additional demand from this proposed modification, no nexus exists for the provision of additional pedestrian and bicycle infrastructure linking the mine site to nearby facilities or services.

8.1.3 Mitigation and Management

The proposed modification will result in no additional impacts to the safety and efficiency of the local road network and no additional mitigation or management measures are required.

8.1.4 Conclusion

The local road network likely to be impacted on by the proposed modification is Summerhill Drive, Wangi Road and Donnelly Road. Traffic data collected on the local road network indicates that Summerhill Drive and Donnelly Road have spare midblock capacity to cater for additional traffic generated by the proposed modification. The peak traffic generation period associated with Myuna Colliery will occur during shift changes between day shift and afternoon shift at 2:30 pm.

The increase in traffic on the local road network will not cause the mid-block capacity of the local road network to be reached therefore subject to satisfactory intersection operation the proposed modification will not adversely impact on the local road network.

Sidra modeling of the intersections likely to be impacted by the proposed modification has determined that they will continue to operate satisfactorily after the proposed staff increases. The LOS for each turning movement is good (LOS A) and there is little if any delay for motorists.

The existing Myuna Colliery vehicular entrance intersection (Summerhill Drive / Wangi Point Road) has satisfactory sight distance therefore does not require to be upgraded as a result of the proposed modification and the proposed modification will not impact on the safety and efficiency of the public road network.

The proposed modification will not result in any on-street car parking occurring in the vicinity of the site as a result of any additional parking demand during peak periods. Onsite parking is an internal traffic management issue for CMPL.

The Myuna Colliery Surface Facilities Area is not currently serviced by public transport nor are there any pedestrian and bicycle facilities linking the site to nearby services and facilities. As a result there is very little if any dependence by employees on alternate transport modes to access the site. Whilst the proposed modification will generate additional employees it is not considered that the demand for alternate transport modes will be enough to warrant the extension of public transport and pedestrian / bicycle infrastructure to the site.

8.2 Air Quality

An Air Quality Impact Assessment has been prepared by SLR Consulting Australia Pty Ltd to support the proposed modification and has been provided as **Appendix C** to this EA.

8.2.1 Existing Environment

The air quality in the region surrounding the Myuna Colliery Surface Facilities Area is influenced by emissions generated by a range of sources, originating from both within and outside of the local area. Specifically, for the area surrounding the Myuna Colliery Surface Facilities Area, air quality will be influenced by pollution transported into the area from more distant sources, emissions from power stations in the area, traffic-generated pollution and pollution generated by the operations themselves.

Deposited Dust

CMPL has a current dust deposition monitoring program in place which covers the Surface Facilities Area. The locations of the dust deposition gauge (DDG) sites relevant to the Myuna operations are shown in **Figure 9**.

A summary of the dust deposition monitoring program is shown in **Table 13**.

Table 13 - Summary of the Dust Deposition Monitoring Program at Myuna Colliery

Gauge #	Monitoring Period	Average Deposition Rate (g/m ² /month)
D1	July 2002 – August 2014	0.7
D2	July 2002 – August 2014	1.0
D3	July 2002 – August 2014	1.7
D4	July 2002 – August 2014	1.3
Overall Average		1.2

It is noted that the long term average dust deposition rates shown in **Table 13** include the contribution of mining operations and the background dust levels.

There have been no exceedances of the dust deposition criteria at the Myuna Colliery.

TSP

TSP monitoring has performed on a 1-in-6 day cycle at the Myuna Colliery Surface Facilities Area since August 2013. The results of TSP monitoring undertaken for the 12 month period from August 2013 to August 2014 indicates that the annual average TSP concentration was 29.6 µg/m³ inclusive of power station and Myuna's operations.

There have been no exceedances of the TSP criteria in the twelve months of monitoring conducted to date.

PM10

Air quality monitoring of PM₁₀ has been performed at the Myuna Colliery Surface Facilities Area since August 2013 using a High Volume Air Sampler (HVAS) operating on a 1-in-6 day cycle. This monitoring is performed to assess the compliance of the operations with Project Approval conditions

Measurements of PM₁₀ measured include the impacts of power station and Myuna's operational related emissions. The results of PM10 monitoring undertaken for the 12 month period from August 2013 to August 2014 are shown in **Table 14** below.

Table 14 - Summary of the PM10 Monitoring Program at Myuna Colliery

Date	Myuna Colliery	
	Average (µg/m ³)	Maximum (µg/m ³)
August 2013 to August 2014 (1 in 6 day)	14.5	38.0

There have been no exceedances of the PM10 criteria in the twelve months of monitoring conducted to date.

Background Air Quality

SLR utilised regional background air quality data from monitoring sites operated by the Environmental Protection Authority (EPA) at Newcastle, Beresfield and Wallsend, supplemented with emissions to atmosphere from the Vales Point and Eraring power stations. A dispersion modelling exercise was undertaken by SLR using publicly available information, specifically stack sources associated with the power stations, to determine the contribution from power station emissions. In addition to emissions from stack sources, emissions from coal stockpiles and ash dams were also considered by SLR using the National Pollutant Inventory (NPI) default values.

The site-specific ambient air quality levels adopted by SLR are summarised in **Table 15**.

Table 15 - Ambient Air Quality

Air Quality Parameter	Averaging Period	Assumed Background Ambient Level	Notes
TSP	Annual	29.4 µg/m ³ PLUS Power Station Increments	Maximum Increment due to Power Station is 8 µg/m ³ at Receptor R5
PM ₁₀	24-hour	Varying	Maximum Increment due to Power Station is 4 µg/m ³ at Receptor R5
	Annual	14.7 µg/m ³ PLUS Power Station Increments	

Air Quality Parameter	Averaging Period	Assumed Background Ambient Level	Notes
PM _{2.5}	24-hour	Varying	Maximum Increment due to Power Station is 1.2 µg/m ³ at Receptor R5
	Annual	4.6 µg/m ³ PLUS Power Station Increments	
Deposited Dust	Annual	2 g/m ² /month	Assumed
Odour	1-hour	0 OU	Assumed

8.2.2 Impact Assessment

Air Quality Goals

Air quality impact assessment criteria adopted by the EPA are contained in the Approved Methods (DEC 2005). These criteria are derived from a range of sources and are the defining ambient air quality criteria for NSW. They have been developed in consultation with a number of organisations, including the National Health and Medical Research Council (NHMRC), National Environment Protection Council (NEPC), World Health Organisation (WHO) and ANZECC.

The air quality goals adopted for this assessment, which conform to current EPA and Federal air quality criteria, are summarised in **Table 16**.

Table 16 - Air Quality Goals

Pollutant	Averaging Time	Goal
TSP	Annual	90 µg/m ³ (NSW EPA)
PM ₁₀	24 Hours Annual Annual	50 µg/m ³ (NSW EPA) 30 µg/m ³ (NSW EPA) 20 µg/m ³ (WHO)
PM _{2.5}	24 Hours Annual	25 µg/m ³ (NEPM interim <u>advisory</u> reporting standard only) 8 µg/m ³ (NEPM interim <u>advisory</u> reporting standard only)
Dust Deposition	Annual	Maximum Incremental (Myuna operations only) increase of 2 g/m ² /month Maximum Total of 4 g/m ² /month (Myuna operations and other sources)
Odour	1-hour	2 OU (99 th percentile)

Scenarios Assessed

Two scenarios have been quantified to assess the pollutant emissions due to currently approved operations (at 2 Mtpa) and proposed operations (at 3 Mtpa). A scenario to assess the impacts of operations at 2 Mtpa extraction rate was presented in “Myuna Colliery Extension of Mining Project, Air Quality Impact Assessment” (SLR (previously Heggies), October 2010). Since the publication of this assessment, a number of emission factors have been updated, and further work has been performed at the site with regard to emission control which warrants a re-assessment of these impacts.

A summary of the emission sources assessed in both scenarios is shown in **Table 17**.

Table 17 – Summary of Emission Sources

Emission Source	Pollutants
Transfer of coal from underground workings to surface ROM bin	TSP, PM ₁₀ , PM _{2.5} and deposited dust
Transfer of coal from ROM bin to breaker	
Coal breaking	
Transfer of coal from breaker to screen	
Coal screening	
Transfer of coal from screen to crusher	
Coal crushing	
Transfer of coal from crusher to finished product bin	
Transfer of finished product to Eraring Power Station	
Loading of coal from ROM bin to trucks	
Hauling of coal from ROM bin to Emergency Stockpile (and return)	
Unloading/loading of coal at Emergency Stockpile	
Movement of coal at Emergency Stockpile	
Wind erosion of Emergency Stockpile and two water storage dams (when not at capacity)	
Truck unloading to reclaim bin	
Upcast ventilation	TSP, PM ₁₀ , PM _{2.5} , deposited dust and odour

A summary of the existing control measures identified as currently being implemented at Myuna Colliery is provided in **Table 18**. These controls will also be implemented as part of the proposed modification operations.

Table 18 – Control Factors Assumed for Existing Control Measures

Dust Mitigation Measure	Applied Control Factor	Notes
Induction training	NA	No quantification can be made
Modification of operations in unfavourable weather conditions	NA	No quantification can be made
Sealing of haul roads	100%	-
Vehicle speed restrictions	NA	No quantification can be made
Servicing of water carts	NA	No quantification can be made
Use of additional water trucks as required around CHP and Emergency Coal Stockpile	NA	No quantification can be made
Cleaning up coal spillage at CHP	NA	No quantification can be made
Water sprays and enclosure of conveyor transfer points and Breaker/Crusher/Screen	70%	-
Watering of Emergency Coal Stockpile when in use	50%	Also applied to other operations at the Emergency Coal Stockpile: Truck unloading to ROM stockpile; Front end loader on coal; and, Loading coal to truck:

Emissions associated with the proposed modification were modelled by SLR using the US EPA's CALPUFF (version 6.267) modelling system, which is a multi-layer, multi-species, non-steady state puff dispersion modelling system that can simulate the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal. The advantages of using CALPUFF (rather than using a steady state Gaussian dispersion model such as AUSPLUME) is its ability to handle calm wind speeds (i.e. less than 0.5 metres per second) and the effects of complicated terrain on plume dispersion. Detailed information regarding the adopted dispersion meteorology is presented in SLR's report in **Appendix C**.

Dust Deposition

Model predictions of the annual average dust deposition rate experienced at all receptors presented in **Table 1** during currently approved (2 Mtpa) and proposed (3 Mtpa) mining activities are presented in **Table 19**. The background deposition rate of 2 g/m²/month has been included to determine the cumulative deposition rate associated with all existing operations in the area and the predicted impact from power stations has also been include.

Table 19 - Predicted Annual Average Dust Deposition (g/m²/month)

Receptor	Currently Approved (2 Mtpa)				Proposed (3 Mtpa)			
	B/G	Inc	PS	Cumu	B/G	Inc	PS	Cumu
R1	2.0	<0.1	<0.1	2.2	2.0	<0.1	<0.1	2.2
R2	2.0	<0.1	<0.1	2.2	2.0	<0.1	<0.1	2.2
R3	2.0	<0.1	<0.1	2.2	2.0	<0.1	<0.1	2.2

Receptor	Currently Approved (2 Mtpa)				Proposed (3 Mtpa)			
	B/G	Inc	PS	Cumu	B/G	Inc	PS	Cumu
R4	2.0	0.1	<0.1	2.2	2.0	0.1	<0.1	2.2
R5	2.0	0.1	<0.1	2.2	2.0	0.1	<0.1	2.2
R6	2.0	0.1	<0.1	2.2	2.0	0.1	<0.1	2.2
R7	2.0	<0.1	0.1	2.2	2.0	<0.1	0.1	2.2
R8	2.0	<0.1	<0.1	2.2	2.0	<0.1	<0.1	2.2
Criterion	-	2.0		4.0	-	2.0		4.0

Note: B/G = Background, Inc = modelled increment from the proposed modification, PS = modelled increment from Power Stations, Cumu = cumulative impact

Increasing production rate from 2 Mtpa to 3 Mtpa is shown through dispersion modelling to not result in any detrimental impacts upon surrounding receptors.

TSP

Model predictions of the annual average TSP concentration experienced at all receptors presented in **Table 1** during currently approved (2 Mtpa) and proposed (3 Mtpa) mining activities are presented in **Table 20**. The background TSP concentration of 29.5 µg/m³ has been included to determine the cumulative TSP concentration associated with all existing operations in the area and the predicted impact from power stations has also been included.

Table 20 - Predicted Annual Average TSP Concentration (µg/m³)

Receptor	Currently Approved (2 Mtpa)				Proposed (3 Mtpa)			
	B/G	Inc	PS	Cumu	B/G	Inc	PS	Cumu
R1	29.5	0.6	<0.1	30.2	29.5	0.7	<0.1	30.3
R2	29.5	0.4	<0.1	30.0	29.5	0.5	<0.1	30.1
R3	29.5	1.1	<0.1	30.7	29.5	1.4	<0.1	31.0
R4	29.5	1.0	<0.1	30.6	29.5	1.1	<0.1	30.7
R5	29.5	1.3	0.1	30.9	29.5	1.6	0.1	31.1
R6	29.5	1.7	0.2	31.4	29.5	1.8	0.2	31.5
R7	29.5	0.8	0.5	30.7	29.5	0.9	0.5	30.9
R8	29.5	0.7	0.1	30.2	29.5	0.8	0.1	30.3
Criterion	-	-	-	90	-	-		90

Note: B/G = Background, Inc = modelled increment from the Proposed modification, PS = modelled increment from Power Stations, Cumu = cumulative impact

Cumulative annual average TSP concentrations under both the currently approved and proposed scenarios are predicted to be well below the criterion of 90 µg/m³ at all modelled. Increasing production rate from 2 Mtpa to 3 Mtpa is shown through dispersion modelling to not result in any detrimental impacts upon surrounding receptors.

PM10

Annual Average

Model predictions of the annual average PM10 concentration experienced at all receptors presented in **Table 1** during currently approved (2 Mtpa) and proposed (3 Mtpa) mining activities are presented in **Table 21**. The background PM10 concentration of 14.7 µg/m³ has been included to determine the cumulative PM10 concentration associated with all existing operations in the area and the predicted impact from power stations has also been included.

Table 21 - Predicted Annual Average PM10 Concentration (µg/m³)

Receptor	Currently Approved (2 Mtpa)				Proposed (3 Mtpa)			
	B/G	Inc	PS	Cumu	B/G	Inc	PS	Cumu
R1	14.7	0.2	<0.1	15.0	14.7	0.2	<0.1	15.0
R2	14.7	0.1	<0.1	14.9	14.7	0.1	<0.1	14.9
R3	14.7	0.4	<0.1	15.2	14.7	0.4	<0.1	15.2
R4	14.7	0.2	<0.1	15.0	14.7	0.2	<0.1	15.0
R5	14.7	0.3	0.1	15.1	14.7	0.3	0.1	15.1
R6	14.7	0.4	0.1	15.2	14.7	0.4	0.1	15.2
R7	14.7	0.2	0.3	15.2	14.7	0.2	0.3	15.2
R8	14.7	0.2	0.0	14.9	14.7	0.2	0.0	14.9
Criterion	-	-	-	30	-	-	-	30

Note: B/G = Background, Inc = modelled increment from the Proposed modification, PS = modelled increment from Power Stations, Cumu = cumulative impact

Cumulative annual average PM10 concentrations under both the currently approved and proposed scenarios are predicted to be well below the NSW EPA criterion of 30 µg/m³ and the WHO criterion of 20 µg/m³ at all modelled receptors. Increasing production rate from 2 Mtpa to 3 Mtpa is shown through dispersion modelling to not result in any detrimental impacts upon surrounding receptors.

Maximum 24-hour Average

Model predictions of the maximum 24-hour average PM10 concentration experienced at all receptors presented in **Table 1** during currently approved (2 Mtpa) and proposed (3 Mtpa) mining activities are presented in **Table 22** and **Table 23** respectively.

The background PM10 concentration varies by day and therefore the tables include an assessment of the following:

- The maximum cumulative 24-hour average PM10 concentration to enable assessment of compliance against the EPA criterion of 50 µg/m³; and
- The cumulative 24-hour average PM10 concentration during the day when the maximum increment is experienced from the proposed modification operations.

It is shown that the maximum cumulative concentrations under both Scenarios are dominated by background PM10 concentrations. Maximum increments due to the Myuna Colliery operations as a result of the proposed modification are shown to be up to 19 µg/m³. With the inclusion of an additional

approximately 1 µg/m³ resulting from the Northern Coal Logistics Project, the Proposed modification is not predicted to result in any exceedances of the 50 µg/m³ criterion, nor the proposed 40 µg/m³ criterion.

Table 22 - Predicted Maximum 24-hour Average PM₁₀ Concentration (µg/m³) – 2 Mtpa

Receptor	Assessment of Maximum Cumulative Impact				Assessment of Maximum Incremental Impact			
	B/G	Inc.	PS	Maximum Cumu.	B/G	Maximum Inc.	PS	Cumu.
R1	28.6	3.0	1.5	33.2	9.9	8.5	0.1	18.5
R2	32.8	<0.1	0.3	33.2	9.9	7.7	0.1	17.7
R3	32.8	<0.1	0.3	33.2	17.7	14.0	<0.1	31.8
R4	32.8	1.7	0.3	34.8	10.2	7.7	0.6	18.4
R5	32.8	1.9	0.3	35.0	13.3	18.8	<0.1	32.2
R6	32.8	0.4	0.3	33.5	13.3	8.8	<0.1	22.2
R7	32.8	0.1	0.3	33.2	15.7	6.5	0.5	22.7
R8	32.8	<0.1	0.3	33.2	16.7	7.5	0.1	24.3
Criterion				50.0				50.0

Note: B/G = Background, Inc = modelled increment from the Proposed modification, Cumu = cumulative impact

Table 23 - Predicted Maximum 24-hour Average PM₁₀ Concentration (µg/m³) – 3 Mtpa

Receptor	Assessment of Maximum Cumulative Impact				Assessment of Maximum Incremental Impact			
	B/G	Inc.	PS	Maximum Cumu.	B/G	Maximum Inc.	PS	Cumu.
R1	28.6	3.6	1.5	33.8	9.9	8.7	0.1	18.8
R2	32.8	<0.1	0.3	33.2	9.9	8.7	0.1	18.7
R3	25.2	8.3	0.1	33.6	13.5	15.9	<0.1	29.5
R4	32.8	1.9	0.3	35.0	10.2	8.4	0.6	19.2
R5	32.8	1.9	0.3	35.1	13.3	20.0	<0.1	33.4
R6	32.8	0.5	0.3	33.6	13.3	9.9	<0.1	23.3
R7	32.8	0.1	0.3	33.2	15.7	7.2	0.5	23.3
R8	32.8	<0.1	0.3	33.2	16.7	7.8	0.1	24.6
Criterion				50.0				50.0

Note: B/G = Background, Inc = modelled increment from the Proposed modification, Cumu = cumulative impact

Increasing production rate from 2 Mtpa to 3 Mtpa is shown through dispersion modelling to not result in any detrimental impacts upon surrounding receptors. Maximum 24-hour PM₁₀ concentrations are dominated by activities at the emergency coal stockpile which have been modelled to occur on every day of the year to assess maximum potential impacts. Under some years, these operations may not occur, and the concentrations of PM₁₀ may be significantly lower than those modelled.

PM2.5

Annual Average

Model predictions of the annual average PM2.5 concentration experienced at all receptors presented in **Table 1** during currently approved (2 Mtpa) and proposed (3 Mtpa) mining activities are presented in **Table 24**. The background PM2.5 concentration of 4.6 µg/m3 has been included to determine the cumulative PM2.5 concentration associated with all existing operations in the area and the predicted impact from power stations has also been included.

Table 24 - Predicted Annual Average PM2.5 Concentration (µg/m3)

Receptor	Currently Approved (2 Mtpa)				Proposed (3 Mtpa)			
	B/G	Inc	PS	Cumu	B/G	Inc	PS	Cumu
R1	4.6	0.1	<0.1	4.8	4.6	0.1	<0.1	4.8
R2	4.6	<0.1	<0.1	4.8	4.6	0.1	<0.1	4.8
R3	4.6	0.1	<0.1	4.8	4.6	0.1	<0.1	4.8
R4	4.6	0.1	<0.1	4.8	4.6	0.2	<0.1	4.9
R5	4.6	0.2	<0.1	4.9	4.6	0.2	<0.1	4.9
R6	4.6	0.3	<0.1	5.0	4.6	0.3	<0.1	5.0
R7	4.6	0.1	<0.1	4.8	4.6	0.1	<0.1	4.8
R8	4.6	0.1	<0.1	4.8	4.6	0.1	<0.1	4.8
Criterion	-	-	-	8	-	-		8

Note: B/G = Background, Inc = modelled increment from the Proposed modification, PS = modelled increment from Power Stations, Cumu = cumulative impact

Cumulative annual average PM2.5 concentrations under both the currently approved and proposed scenarios are predicted to be well below the advisory reporting standard of 8 µg/m3. Increasing production rate from 2 Mtpa to 3 Mtpa is shown through dispersion modelling to not result in any detrimental impacts upon surrounding receptors.

Maximum 24-hour Average

Model predictions of the maximum 24-hour average PM2.5 concentration experienced at all receptors presented in **Table 1** during currently approved (2 Mtpa) and proposed (3 Mtpa) mining activities are presented in **Table 25** and **Table 26** respectively.

The background PM2.5 concentration varies by day and therefore the tables include an assessment of the following:

- The maximum cumulative 24-hour average PM2.5 concentration to enable assessment of compliance against the advisory standard of 25 µg/m3; and
- The cumulative 24-hour average PM2.5 concentration during the day when the maximum increment is experienced from the Myuna Colliery operations as a result of the proposed modification operations.

It is shown that the maximum cumulative concentrations under both Scenarios are dominated by background PM2.5 concentrations. Maximum increments due to the Myuna Colliery operations as a result of the proposed modification operations are shown to be up to 3 µg/m3. With the inclusion of an

additional <1 µg/m³ resulting from the Northern Coal Logistics Project, concentrations of 24-hour maximum PM_{2.5} are not predicted to be in exceedance of the 25 µg/m³ advisory (and recommended to be adopted) standard at any receptor locations under any scenario assessed.

Table 25 - Predicted Maximum 24-hour Average PM_{2.5} Concentration (µg/m³) – 2 Mtpa

Receptor	Assessment of Maximum Cumulative Impact				Assessment of Maximum Incremental Impact			
	B/G	Inc.	PS	Maximum Cumu.	B/G	Maximum Inc.	PS	Cumu.
R1	18.8	<0.1	0.1	19.0	0.2	1.8	0.1	2.1
R2	18.8	<0.1	0.1	19.0	3.0	1.1	0.4	4.5
R3	18.8	0.3	0.1	19.2	4.8	2.6	<0.1	7.5
R4	18.8	0.9	0.1	19.8	5.1	1.8	0.1	7.0
R5	18.8	0.9	0.2	19.9	6.4	2.6	0.1	9.1
R6	18.8	0.1	0.2	19.1	2.4	2.2	<0.1	4.7
R7	18.8	0.1	0.1	19.0	4.7	1.4	0.1	6.2
R8	18.8	0.1	0.1	19.0	2.8	1.7	<0.1	4.6
Criterion				25.0				25.0

Note: B/G = Background, Inc = modelled increment from the Proposed modification, Cumu = cumulative impact

Table 26 - Predicted Maximum 24-hour Average PM_{2.5} Concentration (µg/m³) – 3 Mtpa

Receptor	Assessment of Maximum Cumulative Impact				Assessment of Maximum Incremental Impact			
	B/G	Inc.	PS	Maximum Cumu.	B/G	Maximum Inc.	PS	Cumu.
R1	18.8	<0.1	0.1	19.0	0.2	1.8	0.1	2.1
R2	18.8	<0.1	0.1	19.0	3.0	1.3	0.4	4.7
R3	18.8	0.4	0.1	19.3	4.8	2.9	<0.1	7.8
R4	18.8	1.0	0.1	19.9	5.1	1.9	0.1	7.1
R5	18.8	0.9	0.2	19.9	6.4	2.8	0.1	9.3
R6	18.8	0.1	0.2	19.1	2.4	2.3	<0.1	4.8
R7	18.8	0.1	0.1	19.0	4.7	1.5	0.1	6.3
R8	18.8	0.1	0.1	19.0	2.8	1.7	<0.1	4.6
Criterion				25.0				25.0

Note: B/G = Background, Inc = modelled increment from the Proposed modification, Cumu = cumulative impact

Increasing production rate from 2 Mtpa to 3 Mtpa is shown through dispersion modelling to not result in any detrimental impacts upon surrounding receptors. Maximum 24-hour PM_{2.5} concentrations are dominated by activities at the emergency coal stockpile which have been modelled to occur on every day of the year to assess maximum potential impacts. Under some years, these operations may not occur, and the concentrations of PM_{2.5} may be significantly lower than those modelled.

Odour

Table 27 presents the 99th percentile 1-hour average odour concentrations predicted by the dispersion modelling at each of the nominated residences/properties. It is noted that the background odour concentration is assumed to be zero.

Table 27 - 99th percentile 1-hour Average Odour Concentrations

Receptor ID	Increment (OU)
R1	1.2
R2	0.6
R3	0.9
R4	1.4
R5	1.5
R6	1.9
R7	1.2
R8	1.1

Note: criterion – 2 OU

It is noted that the 99th percentile 1-hour average odour concentration are predicted to be below the criterion of 2 OU at all eight sensitive receptors.

8.2.3 Mitigation and Management

Existing dust control measures implemented at Myuna Colliery detailed in **Table 18** will continue to be implemented throughout the life of the operation.

Air quality monitoring (1-in-6 day HVAS for PM₁₀ and TSP and dust deposition monitoring) will continue to be performed by CMPL to monitor air quality impacts due to the operations at the Myuna Colliery Surface Facilities Area. The results of the monitoring data will be used to inform the efficacy of control measures.

8.2.4 Conclusion

The findings of the dispersion modelling assessment indicate that (under both the currently approved and proposed operations):

- All annual average particulate impacts (dust deposition, PM₁₀, PM_{2.5}, TSP) are in compliance with advisory reporting standards, NSW EPA and WHO criteria at all receptors assessed;
- All annual average criteria remain in compliance with advisory reporting standards, NSW EPA and WHO criteria when taking into account the Northern Coal Logistics Project;
- Maximum 24-hour PM_{2.5} concentrations are predicted to be below the advisory reporting standard at all receptors assessed, including an approximation of background (i.e. existing air quality); and
- Maximum 24-hour PM₁₀ concentrations are predicted to be below the NSW EPA criterion of 50 µg/m³ (and the potential criterion of 40 µg/m³) at all receptors including an approximation of background (i.e. existing air quality).

- Odour concentrations are predicted to be below the NSW EPA criterion of 2 OU at all receptors assessed.

Through this dispersion modelling exercise, it has been shown that the operation of the Myuna Colliery under both the 2 Mtpa and 3 Mtpa production rates will not cause any exceedances of the adopted criteria at any receptor assessed. Additionally, changes in the air quality resulting from the proposed production increase are predicted to be minimal with impacts dominated by operations at the emergency coal stockpiles, at which operations are not proposed to change.

8.3 Noise

A Noise Impact Assessment was prepared in 2010 by Heggies Pty Ltd as part of the Myuna Colliery Extension of Mining Part 3A application. A review of this Noise Impact Assessment has been undertaken as part of this EA.

8.3.1 Existing Environment

In 2011, an ambient noise monitoring program (attended and unattended) was undertaken by Heggies at two locations in proximity to the Surface Facilities Area which are representative of the nearest potentially affected private receivers. Background noise and average noise levels over a 15 minute period (LAeq(15minute)) noise levels were measured during the day, evening and night-time periods to determine appropriate background levels. These background levels were used to determine project specific noise criteria in accordance with the NSW Industrial Noise Policy for the Myuna Colliery surface operations. The background and project specific noise levels are detailed in **Table 28**.

Table 28 – Background Noise Levels and Project Specific Noise Criteria

Location	Period	Measured Background Noise Level (LA90)	Adopted RBL	Project Specific Noise Criteria
				LAeq(15min)
R1 to R2 (Off Summerhill Drive, Wangi)	Day	35 dBA	35 dBA	40 dBA
	Evening	34 dBA	34 dBA	39 dBA
	Night	30 dBA	30 dBA	35 dBA
R3 (Sunset Close, Wangi Wangi)	Day	No Data	30 dBA	35 dBA
	Evening	No Data	30 dBA	35 dBA
	Night	No Data	30 dBA	35 dBA
R4 to R8 (Donnelly Road Arcadia Vale)	Day	41 dBA	39 dBA	44 dBA
	Evening	40 dBA	37 dBA	42 dBA
	Night	36 dBA	34 dBA	39 dBA

The sleep disturbance criteria that was adopted is shown in **Table 29**.

Table 29 – Sleep Disturbance Noise Goals

Location	Measured Background Noise Level (LA90)	Adopted RBL LA90	Sleep Disturbance Noise Goal*
R1 to R2 (Off Summerhill Drive, Wangi Wangi)	30 dBA	30 dBA	45 dBA
R3 (Sunset Close, Wangi Wangi)	No Data	30 dBA	45 dBA

Location	Measured Background Noise Level (LA90)	Adopted RBL LA90	Sleep Disturbance Noise Goal*
R4 to R8 (Donnelly Road, Arcadia Vale)	36 dBA	34 dBA	49 dBA

8.3.2 Impact Assessment

Noise measurements were conducted for all acoustically significant plant and equipment utilised during operations at the Surface Facilities Area. Where on-site measurements could not be conducted, sound power levels were obtained from a database of similar equipment.

SoundPLAN was used to predict noise emissions from the Myuna Colliery Surface Facilities Area. Noise levels were predicted for the general operational scenario (i.e. 24 hour operation with all equipment operating (i.e. representing a worse-case scenario for the purposes of modelling).

Noise levels predicted at the nearest potentially affected residential locations are provided in **Table 30**.

Table 30 - Predicted Noise Levels – Standard Operational Scenario

Predicted Noise Level LAeq(15minute) (dBA)											Project Specific Noise Criteria (LAeq,15min)
Location	Period	Wind Direction								Temp Inversion	
		Calm	ESE	SE	SSE	S	SSW	SW	WSW		
R1	Day	<30	-	-	-	-	-	-	-	-	40 dBA
	Evening	<30	<30	-	-	-	-	-	<30	-	39 dBA
	Night	<30	<30	<30	<30	<30	<30	<30	<30	<30	35 dBA
R2	Day	<30	-	-	-	-	-	-	-	-	40 dBA
	Evening	<30	<30	-	-	-	-	-	<30	-	39 dBA
	Night	<30	<30	<30	<30	<30	<30	<30	<30	<30	35 dBA
R3	Day	<30	-	-	-	-	-	-	-	-	35 dBA
	Evening	<30	<30	-	-	-	-	-	<30	-	35 dBA
	Night	<30	<30	<30	<30	<30	<30	<30	<30	<30	35 dBA
R4	Day	35	-	-	-	-	-	-	-	-	44 dBA
	Evening	35	35	-	-	-	-	-	40	-	42 dBA
	Night	35	32	36	37	37	38	38	37	37	39 dBA
R5	Day	37	-	-	-	-	-	-	-	-	44 dBA
	Evening	37	34	-	-	-	-	-	42	-	42 dBA

Predicted Noise Level LAeq(15minute) (dBA)											Project Specific Noise Criteria (LAeq,15min)
Location	Period	Calm	Wind Direction							Temp Inversion	
			ESE	SE	SSE	S	SSW	SW	WSW		
	Night	37	31	35	38	39	39	39	39	39	39 dBA
R6	Day	37	-	-	-	-	-	-	-	-	44 dBA
	Evening	37	31	-	-	-	-	-	42	-	42 dBA
	Night	37	<30	32	36	38	38	38	39	38	39 dBA
R7	Day	37	-	-	-	-	-	-	-	-	44 dBA
	Evening	37	31	-	-	-	-	-	42	-	42 dBA
	Night	37	<30	30	34	38	39	39	39	39	39 dBA
R8	Day	37	-	-	-	-	-	-	-	-	44 dBA
	Evening	37	30	-	-	-	-	-	42	-	42 dBA
	Night	37	<30	30	32	36	39	39	39	39	39 dBA

Results presented in **Table 30** indicate that standard operational noise levels are predicted to meet the project specific noise criteria at all modelled residential receivers under calm and prevailing weather conditions. Since the operational scenario modelled is likely to represent an acoustically worst case scenario, actual operational noise levels are likely to be less than those predicted.

As there is no change to surface operations or the assumptions used in the noise modelling undertaken in 2011, these results are still considered relevant.

In the event of break downs or servicing and maintenance of the Enclosed Overland Conveyor, Myuna Colliery temporarily stores coal in a dedicated stockpile in the northern portion of the Surface Facilities Area. Coal is transferred from the emergency hopper to the stockpile by trucks along a sealed haul road. Coal is recovered from the stockpile by a front end loader, loaded onto trucks and dumped into a CHP reclaim hopper for transportation to Eraring Power Station by the Enclosed Overland Conveyor. Emergency stockpiling activities are only anticipated to occur for a maximum period of 3 days per year, with stockpiled coal returned back to the reclaim hopper over a 4 day period. Notwithstanding this, noise calculations were conducted to the nearest affected residences with all standard surface plant in operation, and with trucks transporting coal between the CHP and Emergency Coal Stockpile Area. The noise calculations included the operation of a front end loader operating at the Emergency Coal

Stockpile during the daytime only, as the front end loader does not operate on the stockpile during the evening or night-time periods.

Table 31 presents the predicted noise levels during emergency stockpiling activities.

Table 31 - Predicted Noise Levels – Standard Operational Scenario plus Emergency Coal Stockpiling

Location	Period	Predicted Noise Level LAeq(15minute) (dBA)									Project Specific Noise Criteria (LAeq,15min)
		Calm	Wind Direction							Temp Inversion	
			ESE	SE	SSE	S	SSW	SW	WSW		
R1	Day	37	-	-	-	-	-	-	-	-	40 dBA
	Evening	<30	<30	-	-	-	-	-	<30	-	39 dBA
	Night	<30	<30	<30	<30	<30	<30	<30	<30	<30	35 dBA
R2	Day	<30	-	-	-	-	-	-	-	-	40 dBA
	Evening	<30	<30	-	-	-	-	-	<30	-	39 dBA
	Night	<30	<30	<30	<30	<30	<30	<30	<30	<30	35 dBA
R3	Day	<30	-	-	-	-	-	-	-	-	35 dBA
	Evening	<30	<30	-	-	-	-	-	<30	-	35 dBA
	Night	<30	<30	<30	<30	<30	<30	<30	<30	<30	35 dBA
R4	Day	42	-	-	-	-	-	-	-	-	44 dBA
	Evening	35	35	-	-	-	-	-	40	-	42 dBA
	Night	35	32	36	37	37	38	38	37	37	39 dBA
R5	Day	44	-	-	-	-	-	-	-	-	44 dBA
	Evening	37	34	-	-	-	-	-	42	-	42 dBA
	Night	37	31	35	38	39	39	39	39	39	39 dBA
R6	Day	42	-	-	-	-	-	-	-	-	44 dBA
	Evening	37	31	-	-	-	-	-	42	-	42 dBA
	Night	37	<30	32	36	38	38	38	39	38	39 dBA
R7	Day	42	-	-	-	-	-	-	-	-	44 dBA
	Evening	37	31	-	-	-	-	-	42	-	42 dBA
	Night	37	<30	30	34	38	39	39	39	39	39 dBA
R8	Day	41	-	-	-	-	-	-	-	-	44 dBA
	Evening	37	30	-	-	-	-	-	42	-	42 dBA
	Night	37	<30	30	32	36	39	39	39	39	39 dBA

Results presented in **Table 31** indicate that when the emergency coal stockpile is being utilised, operational noise levels are predicted to meet the project specific noise criteria at all modelled residential receivers under calm and prevailing weather conditions.

As there is no change to surface operations or the assumptions used in the noise modelling undertaken in 2011, these results are still considered relevant.

The likelihood of sleep disturbance from typical night-time sources was also assessed. The highest L_{Amax} noise level at any residential area is predicted to occur as a result of forklift pass-by events in the materials yard under the influence of a temperature inversion. External noise levels up to L_{Amax} 43 dBA may occur at residences on Donnelly Road under these circumstances. Predicted noise levels meet the recommended sleep disturbance noise goal of 49 dBA on Donnelly Road. Maximum noise levels on Summerhill Drive (R1 and R2) and Sunset Close (R3), Wangi Wangi are predicted to be below L_{Amax} 30 dBA and as such meet the relevant sleep disturbance noise goal.

Condition 11 of Schedule 3 within PA 10_0080 sets noise criteria limits on the operations at the Myuna Colliery Surface Facilities. These noise criteria are detailed in **Table 32** below.

Table 32 – PA 10_0080 Noise Criteria

Location	Day	Emergency Day	Evening	Night	
	L _{Aeq} (15 min)	L _{Aeq} (15 min)	L _{Aeq} (15 min)	L _{Aeq} (15 min)	L _{A1} (1 min)
R1, R2 and R3	35	40	35	35	45
R4	35	44	40	38	49
R5, R6, R7 and R8	37	44	42	39	49
All other privately-owned land	35	40	35	35	45

Myuna Colliery has installed a permanent noise logger as part of a new site Noise Management Plan in response to PA 10_0800. Section 7.1.2 of the Noise Management Plan details the quarterly monitoring requirements and provides the basis for the quarterly noise monitoring assessments.

Attended noise monitoring at Myuna Colliery is undertaken quarterly by an independent contractor during the day, evening and night periods as defined by condition L5.2 of EPL 366.

The attended noise monitoring has shown Myuna Colliery to be compliant with the noise criteria at all sensitive receiver locations and all times.

8.3.3 Mitigation and Management

Despite predicted and actual noise levels meeting the noise goals and noise criteria within the Project Approval, the following noise mitigation and management strategies were identified to be implemented as

part of the Noise Impact Assessment completed in 2011 by Heggies. These noise management measures have been implemented and will continue to be implemented for the life of the operation.

- All enclosure doors on the rotary breaker, crusher and crusher conveyor drive house will remain closed during the night-time period, specifically:
 - o Roller shutter doors on the north-east and south-west façades of the crusher enclosure; and
 - o Wire frame doors on the north-east façade and northern corner of the rotary breaker to be replaced with solid doors and kept closed at night-time.
- The forklift will not conduct activities, such as moving metal objects around the materials yard, during the night-time period.
- Employees will be briefed on the requirement to minimise noise during the night-time period.

8.3.4 Conclusion

The modification will not result in any changes to surface activities considered as part of the Noise Impact Assessment by Heggies in 2011. Operational noise levels are predicted to continue to meet the project specific noise criteria and the Project Approval consent condition at all assessed residential receivers under calm and prevailing weather conditions.

8.4 Groundwater

A Water Management Assessment was prepared by GHD in 2010 as part of the Myuna Colliery Extension of Mining Part 3A application. A review of this Water Management Assessment has been undertaken as part of this EA.

In addition, a review of the 2010 Myuna Colliery hydrogeological model and water and salt balance (prepared by GHD) and the 2014 Myuna Colliery hydrogeological model and regional water and salt balance was undertaken by GHD and is provided as **Appendix D** to this EA.

8.4.1 Existing Environment

The groundwater sources in the vicinity of Myuna Colliery are generally low yielding and predominantly within the Quaternary alluvium, weathered and/or fractured rock and coal seams.

Quaternary Water Sources

The Quaternary material includes alluvium, which occurs along the watercourses draining into Lake Macquarie, and lake sediment underlying Lake Macquarie. The alluvium forms an unconfined shallow aquifer with a thickness of up to 10 m and is managed under the WSP for the Hunter Unregulated and Alluvial Water Sources. This WSP commenced in August 2009 and regulates the interception and extraction of surface water and alluvium within the defined WSP area.

Porous and Fractured Rock Water Sources

Groundwater flow within the Triassic and Permian rocks underlying the Myuna Colliery holding boundary is predominantly within the coal seams. The overburden and interseam strata tend to have very low hydraulic conductivities (unless fracturing creates a secondary permeability). These water sources are not currently managed under a WSP, although it is understood that a WSP for the North Coast Fractured and Porous Rock Groundwater Sources is currently under development and is due to commence in July 2015.

Daily underground water extraction is the only groundwater monitoring undertaken at Myuna Colliery. Daily extraction volumes recorded between January 2010 and November 2013 are shown in Figure 1. The average underground water extraction during 2013 was 6.4 ML/day. Centennial Myuna has advised that the underground storages at Myuna Colliery are managed so that water levels generally remain constant. Therefore, it is assumed that the average extraction rate of 6.4 ML/day represents the average groundwater seepage for 2013. The recorded data indicates that 40% of the extracted volumes are from the Wallarah Seam workings.

8.4.2 Impact Assessment

GHD Pty Ltd (GHD) has revised the hydrogeological model for Myuna Colliery as part of the preparation of the Northern Operations Regional Water and Salt Balance (GHD, 2014). The original hydrogeological model was developed in 2010 to support the Part 3A project application for Myuna Colliery (GHD, 2010). A three dimensional eight layer numerical hydrogeological model has been constructed to estimate

groundwater inflow into the underground workings at Myuna Colliery up to 2200. The results of this modelling have been incorporated into the Northern Regional Water and Salt Balance.

Hydrogeological modelling was undertaken using the MODFLOW-NWT solver of the MODFLOW 2005 groundwater modelling code. The model was constructed using the GMS graphical user interface with reference to the NSW Aquifer Interference Policy and Australian Groundwater Modelling Guidelines (Barnett et al., 2012). The hydrogeological model was calibrated under transient conditions using available underground water extraction data.

The calibrated hydrogeological model was used to provide estimates of future groundwater inflows and dewatering volumes under approved and proposed conditions.

The results of the modelling shows the total predicted groundwater inflows into the Myuna workings are predicted to peak at 7.5 ML/day in year 2032.

The original hydrogeological model predicted that groundwater inflows would peak at 28.4 ML/day, and 8.3 ML/day would be extracted (GHD, 2010). The original hydrogeological model for Myuna was highly conservative because underground water storage levels were not being monitored and that only a proportion of groundwater inflow was extracted within each seam, resulting in ongoing flooding of some areas of old workings. Therefore, groundwater inflow exceeded extraction from underground workings. As such, overall a conservative model was built due to lack of data of the underground water system. As part of the review and calibration of the hydrogeological model undertaken in 2014, additional information and data was made available from Centennial Myuna which included that

- all groundwater inflow is extracted
- the extraction of groundwater volumes was actually equal to groundwater inflows; and
- underground storages are managed to maintain certain levels.

Recalibrating the model on this basis resulted in a substantially reduced groundwater inflow.

The current total groundwater extractions from the North Coast Fractured and Porous Rock Groundwater Sources within the regional water and salt balance study area are estimated to be approximately 16,600 ML/year on average, of which approximately 8,000 ML/year on average is extracted by Centennial-owned sites (including approximately 2,700 ML/year from Myuna Colliery). Peak extraction from the groundwater source is predicted to occur in 2020 at an average rate of approximately 18,900 ML/year. Extraction of groundwater from Centennial-owned sites is predicted to peak in 2020 at an average of approximately 9,200 ML/year. By the end of the assessment period in 2050, groundwater extraction from Centennial owned sites is predicted to occur at an average rate of approximately 4,800 ML/year. Overall, groundwater extraction at Myuna Colliery represents up to approximately 15% of total groundwater extraction from the North Coast Fractured and Porous Rock Groundwater Sources within the regional water and salt balance study area.

There are no extractions from the alluvium within the HUA WSP from Centennial-owned or non-Centennial sites. As part of the 2011 EIS for the Myuna Part 3A application, negligible changes in groundwater levels in the shallow alluvial aquifers were predicted during the life of Myuna's operation due to the limited connection between the shallow alluvial aquifers and the deeper coal seam aquifers that were to be affected. It was considered that the variation in groundwater levels in the shallow alluvial aquifers is attributable to changes in rainfall recharge and evaporation. Therefore, impacts on alluvial aquifers, existing alluvial groundwater users and Groundwater Dependent Ecosystems (GDEs) resulting from the proposed Project would be minimal, and therefore significant impacts to the groundwater environment were not expected. The proposed increase in production rate from 2 Mtpa to 3 Mtpa does

not change the predicted impacts to alluvial aquifers, existing alluvial groundwater users or Groundwater Dependent Ecosystems (GDEs).

8.4.3 Mitigation and Management

The proposed modification will not result in any additional groundwater impacts to those previously assessed and approved. No additional groundwater mitigation or management measures are required.

8.4.4 Conclusion

Based on the results from transient Run 10 (best fit run under transient calibration), total groundwater inflows into the Myuna workings under approved conditions are predicted to peak at approximately 7.5 ML/day in year 2032. For the proposed extraction rate of 3 Mtpa, total groundwater inflow into the Myuna workings is predicted to peak at approximately 7.9 ML/day in 2020. This is a decrease in predicted groundwater inflows from the original modelling undertaken in 2010 as part of the Myuna Colliery Extension of Mining Part 3A application. Overall, groundwater extraction at Myuna Colliery represents up to approximately 15% of total groundwater extraction from the North Coast Fractured and Porous Rock Groundwater Sources within the regional water and salt balance study area.

8.5 Water Management

A Water Management Assessment was prepared by GHD in 2010 as part of the Myuna Colliery Extension of Mining Part 3A application. A review of this Water Management Assessment has been undertaken as part of this EA.

In addition, a review of the 2010 Myuna Colliery water and salt balance (prepared by GHD) and the 2014 regional water and salt balance was undertaken by GHD and is provided as **Appendix D** to this EA.

8.5.1 Existing Environment

Lake Macquarie, a large coastal lake in New South Wales, has an open water area of 115.1 square kilometres, a perimeter of 196.15 kilometres (OzCoasts, 2010), and supports a range of aquatic ecosystems and recreational uses. Lake Macquarie is a wave-dominated estuary, meaning the estuary has a high sediment trapping efficiency, naturally low turbidity and salt wedge/partially mixed circulation where there is likely to be sedimentation (OzCoasts, 2010). The lake bed is generally flat, averaging 7 metres in depth though deepens to approximately 11 metres in places. The total catchment area is 786 square kilometres (OzCoasts, 2010) and falls under the jurisdiction of the Hunter-Central Rivers Catchment Management Authority (CMA). The estuary is 24 kilometres long, from north to south and 3.2 kilometres at its widest point from east to west (Cardno Ecology Lab, 2010).

Two watercourses are located in the northern portion of the Modification Application Area, Sawmill Creek and Wangi Creek, which drain into Lake Macquarie. Wangi Creek directly traverses the Surface Facilities Area. Postmistress Creek and its tributaries and several other unnamed creeks traverse the Morisset Peninsula within the southern portion of the Modification Application Area.

Myuna Colliery does not extract water from natural watercourses, however it does discharge both groundwater and rainfall runoff into Wangi Creek, through Licenced Discharge Points under the Colliery's EPL 366. Wangi Creek is a heavily modified waterway as a result of the Wangi Power Station outflow canal.

As is detailed in **Section 3.9** of this EA, water management at Myuna Colliery is undertaken in accordance with the approved Myuna Colliery Water Management Plan.

Five water quality monitoring point locations are associated with the Myuna Colliery Surface Facilities Area. These are shown on **Figure 9** and referred to as:

- 'Upstream', located some 500 metres upstream of the confluence of the channel conveying discharge water from Myuna Colliery to Wangi Creek and considered to be the most representative of background water quality;
- 'Downstream', located approximately 180 metres downstream of the confluence;
- 'Lake Macquarie' (located approximately 1 kilometre from the upstream monitoring location); and
- LDP A and LDP B.

8.5.2 Impact Assessment

The assessment of water quality data (GHD 2011), completed as part of the Myuna Colliery's Part 3A application, for the upstream, downstream and LDP locations indicated that the quality of water leaving the Myuna Colliery Surface Site was typically better than the water quality of the receiving waters in Lake Macquarie. The exception to this was elevated levels of manganese leaving the site. Although manganese concentrations were within the site specific limits defined for the operations at Myuna Colliery (which are lower than ANZECC /ARMCANZ (2000) guidelines), there were elevated concentrations of manganese discharged from the site compared to the receiving waters of Lake Macquarie. In accordance with a Pollution Reduction Program (PRP) on EPL 366, CMPL commenced an ANZECC water quality assessment in 2013 and is due for completion and submission to the NSW EPA by February 2015.

A water and salt balance was also prepared by GHD as part of the Myuna Colliery Extension of Mining Part 3A application. The results of this predicted a required increase of 11.6 ML/day of water flowing into the proposed workings from the three coal seams, due to the increased extent of mining. The increase in discharge would be an incremental change, with an average daily increase of 3.2 ML (to a total daily average of 8.6 ML) of expected to occur over the 21 year life of mine.

The impact on the hydrology, geomorphology and water quality of surface waterways and receiving waters as a result of the Myuna Extension Project was expected to be negligible, with monitoring and management programs now established to monitor potential impacts.

In 2014, a revised Northern Operations Water and Salt Balance was developed to assist Centennial Coal to understand the potential cumulative impact of current and future operations on the regional water and salt balance by considering the cumulative water inputs and outputs of both Centennial-owned and non-Centennial operations in the region. GHD Pty Ltd (GHD) was engaged by Centennial Coal to develop this region water and salt balance as well as compare current and future discharges with Centennial's Environment Protection Licence (EPL) limits.

The Northern Operations Water and Salt Balance considers the cumulative impact of coal mining and other operations on licensed water extractions and discharges.

The results of the regional water and salt balance indicate that the total water discharges to the North Lake Macquarie Water Source are dominated by discharges from Eraring Power Station. Current total discharges are estimated to be 4.0 GL/year on average. This is expected to decrease to approximately 7,600 ML/year after 2030, when Eraring Power Station is expected to cease discharging with decommissioning of the power station.

Not considering discharges from Eraring Power Station, total discharges to the North Lake Macquarie Water Source are currently estimated to be approximately 8,900 ML/year. Peak discharge to the North Lake Macquarie Water Source is predicted to occur in 2019 at an average rate of 10,400 ML/year. Peak discharge from Myuna Colliery is predicted to be approximately 2,050 ML/year or 20% of total discharges to the North Lake Macquarie Water Source (excluding Eraring Power Station).

The modelling indicates that the current volumetric discharge limits at LDP A and LDP B (**Table 5**) are sufficient for the life of the mine.

In regards to salt loads, with discharges from Eraring Power Station considered, current total discharges of salt into the North Lake Macquarie Water Source are estimated to be approximately 148 Mtpa on average with salinity of approximately 56,000 µS/cm. This is predicted to decrease to approximately 10,600 t/year with salinity of approximately 2,100 µS/cm after 2030, when Eraring Power Station is expected to cease discharging with decommissioning of the power station.

Not considering discharges from Eraring Power Station, current total discharges of salt to North Lake Macquarie Water Source are estimated to be approximately 61,700 t/year with salinity of 9,100 $\mu\text{S/cm}$. Of this, approximately 53,800 t/year of salt with salinity of 14,100 $\mu\text{S/cm}$ is discharged by Centennial owned

sites. Salt discharged from all sites is predicted to peak in 2020 at a rate of approximately 63,700 t/year with salinity of approximately 9,300 $\mu\text{S/cm}$. Salt associated with Centennial-owned sites is predicted to peak in 2019 at approximately 56,500 t/year with salinity of approximately 12,300 $\mu\text{S/cm}$. Over the period to 2020, over 80% of total salt discharged to the North Lake Macquarie Water Source is from Myuna Colliery.

8.5.3 Mitigation and Management

The proposed modification will not result in any additional changes to the sites water management system or result in impacts beyond those previously assessed and approved. No additional water management mitigation or management measures are required.

8.5.4 Conclusion

As a result of the Myuna Colliery operations, peak discharges are predicted to be approximately 2,050 ML/year or 20% of total discharges to the North Lake Macquarie Water Source (excluding Eraring Power Station).

Excluding Eraring Power Station, over the period to 2020, over 80% of total salt discharged to the North Lake Macquarie Water Source is from Myuna Colliery.

The impact on the hydrology, geomorphology and water quality of surface waterways and receiving waters as a result of the proposed modification are not expected to change beyond those previously assessed and approved.

8.6 Socio Economic

Despite there being many definitions, a Social Impact Assessment (SIA) is, in broad terms, the investigation of:

- the likely change that a proposal will have on people and communities;
- who will be effected and how; and
- the effect of that change.

The term social impact is often seen as having a negative connotation however it should be noted that the scope of the social impacts can be classified as:

- The desirable and undesirable social impacts.
- The intentional and unintentional social impacts.
- The distributional social impacts (impacts experienced by different people and different parts of the community).

A SIA is a systematic, staged approach of enquiry with the core stages being:

Profiling: This involves the understanding of the scale and scope of the proposed modification, parameters of the SIA, identification of the stakeholders (determined by the areas of affectation).

Scoping: This involves the identification of the likely impacts arising from the development and includes consultation and feedback from identified stakeholders. Consultation is undertaken in a range of ways and may include informal consultation, stakeholder engagement, surveys etc.

Assessment: This section explores the likely impacts that will arise. The scope of the assessment is determined by the likely impacts and as a guide may include (but not be limited to),

- Changes to the population and characteristics of the area
- The community structure, its character or beliefs
- The health and safety of those living and working in the vicinity of the development
- An assessment of safety as it relates to crime, anti social and nuisance behaviour
- Social cohesion, in particular the quality of life of those living in the vicinity of the development
- Cost of living, including housing affordability
- Accessibility
- Sense of Place and community
- The impact on existing services

Management: All impacts should be identified and those that are identified as having an adverse or detrimental affect need to be managed and mitigated where possible. It is not always possible to manage all adverse impacts however identification of these impacts and how they can be managed must be taken into account. Similarly impacts that are identified as being positive need to also be identified and

capitalised upon where possible and appropriate. This allows for an assessment as to whether the proposal meets net community benefit criteria.

Monitoring: Strategies to monitor identified impacts may need to be identified to ensure that management strategies are adhered to and those cumulative impacts are identified, monitored and taken into account with further development.

8.6.1 Existing Environment

Myuna Colliery's Surface Facilities Area is at Wangi Wangi. Wangi Wangi is a small residential community on the western shore of Lake Macquarie. It has a small commercial / retail centre servicing the day to day needs of residents. Wangi Wangi is also popular with tourists for both day visitors (boating etc) and is also a destination point for people staying for extended periods at the caravan park and other small tourist related accommodation facilities.

The mining lease area also includes other neighbouring communities along the western shore of Lake Macquarie. These primarily include; Arcadia Vale; Buttaba; Fishing Point and Coal Point.

Like Wangi, these communities are predominately residential and some have small commercial and retail facilities servicing incidental and day to day needs. The main commercial and retail centres would include Morisset and Toronto with higher order services provided in Lake Haven and Tuggerah in the Wyong Shire or Glendale in Lake Macquarie.

The community in the abovementioned residential areas is undergoing some changes. Original settlement saw people working in fishing, forestry or mining and energy sectors. Now the areas are characterised by people who are professionals, managers and technicians and trades workers. School education and hospitals are the most common industry of employment. Mining is represented in some of the areas industry of employment however it is no longer a predominant industry for the areas.

The change is resulting in a community which is generally becoming more professional and affluent. This is found through an assessment of changing professional status over the past 10 – 15 years; income earned etc. This change is also evidenced via the redevelopment of existing residential properties. Current smaller dwellings are making way for much larger dwellings again supporting the view of the changing demographics of the westlakes area.

This type of development could bring about a rapid change in community attitudes; away from the past history and connection with mining and associated manufacturing; towards a community that is less tolerant of existing industry and will not tolerate any change to their current lifestyle.

The areas are also becoming popular with retirees. The influx of older residents will also represent a significant change in opinions and attitudes and lifestyle factors (general amenity of the area, access to social and recreational resources / infrastructure) will be an important consideration for this group of residents.

An overview of the population characteristics for the Lake Macquarie Local Government Area and West Lakes areas are shown in the following tables.

Table 33 - Population Characteristics Lake Macquarie LGA

	2001	2006	2011
Median age of persons	38	40	41
Median total personal income	313	392	517

	2001	2006	2011
(\$/weekly)			
Median total family income (\$/weekly)	849	1,113	1,396
Median total household income (\$/weekly)	705	920	1,114
Median mortgage repayment (\$/monthly)	867	1,300	1,733
Median rent (\$/weekly)	145	185	256
Average number of persons per bedroom	1.1	1.1	1.1
Average household size	2.6	2.6	2.5

Table 34 - Population Characteristics West Lakes

	2001	2006	2011
Median age of persons	39	41	43
Median total personal income (\$/weekly)	298	373	475
Median total family income (\$/weekly)	782	1,047	1,228
Median total household income (\$/weekly)	660	839	981
Median mortgage repayment (\$/monthly)	867	1,300	1,724
Median rent (\$/weekly)	140	180	250
Average number of persons per bedroom	1.1	1.1	1.1
Average household size	2.6	2.5	2.5

Demographic data for the primary residential areas within the current mine lease area as identified above tells us that the area is characterised by:

- Families with children and older retirees.
- There is an increasing number of professionals, managers and technicians and trades workers.
- School education is the primary industry of employment.
- Mining is not a dominant industry of employment and neither are power stations or electricity supply.
- The areas are generally higher in socio-economic status than that of the LGA. This is an ongoing change and more rapid change will occur as there is in-migration for relatively cheaper water front housing than in other parts of the coast.
- Fishing Point and Coal Point have the highest socio-economic status (according to the base data used here) and there is a higher level of home ownership (purchased or purchasing).

8.6.2 Impact Assessment

Myuna Colliery is a long standing existing operation and the proposed modification will see the continuation of this operation. Few complaints have been received from the community over the life of the Colliery. Myuna Colliery has supported sponsorship of initiatives at Arcadia Vale Public School, Wangi Peter Pan Kindergarten, Lake Macquarie Combined Fishing Club, Wangi Netball Club, Rathmines Public School, Powerhouse Christian Church, Wangi Lawn Bowling Club, Wangi Lions Club and the Wangi Beautification Project, Wangi Dobell Festival of Arts and Crafts, the Wangi Men's Shed and West Lake Soccer Club.

The proposed modification will result in the employment of an additional 90 employees above current staff levels at the site. These jobs will principally be filled by Centennial Coal employees displaced by the placement under care and maintenance of Newstan Colliery.

Socio-economic benefits associated with the proposed modification include the maintenance of wage distribution within the community, and rates, royalties and taxes payable to local, state and federal governments. Some proportion of these government revenues will notionally be returned to the local community. This will also positively impact the community by providing a source of economic growth for the area.

Retention of these 90 employees and the positive contribution made through spending a significant proportion of their incomes in the local and regional economies also avoids costs associated with these employees becoming redundant. For example, these households will avoid economic costs and potential social dislocation relating to relocation to find alternative employment. Similarly potential costs to governments and community organisations relating to unemployment will also be avoided if the application is successful,

As the majority of employees are already resident in the local area or region more broadly, their continued employment will place no additional demand on publicly provided goods and services. This will avoid the imposition of further costs on the local, regional and state communities.

As detailed in the sections above, there are some changes to the air and traffic profile of the area which may bring about some changes to the social amenity at certain locations as a result of the proposed modification. It is noted however that all air quality and noise criteria are within compliance.

These potential impacts on the local community have been investigated according to the criteria set out in the following tables.

Table 35 – Population Characteristics

Affect	Assessment Criteria
The development will change the characteristics of the general population or persons who live or interact in or around any site in question.	• Purchase property due to adverse social amenity impacts that cannot be mitigated. • Existing landholders relocate from the area due to mine operations and loss of social fabric, knowledge, networking and sense of community. • Increased in the number of tenancies across the area due to property in mine ownership. This results in different values to the area, land management practices and loss of social fabric, neighbouring etc). • FI/FO or DI/DO workers coming to the area resulting in positive financial contribution to some sectors however do not contribute to the sense of community and create other impacts such as increased housing costs.

Table 36 – Disadvantage and Benefit

Affect	Assessment Criteria
It is likely the development will disadvantage or benefit, individuals or groups (including specific target/population groups).	• Positive pay packet effect in the immediate local area to some / all sectors. • Positive pay packet effect however not in the immediate area, but on a broader regional level. • Increase in housing rental and housing purchase prices due to demand brought about by the project. • Increased number of housing investors taking advantage of accommodation demand for mine personnel. • Artificial increase in pricing for certain commodities / goods / housing. • Sterilisation of land for private development. • Reduced access to publicly accessible land.

Table 37 - Employment

Affect	Assessment Criteria
Changes to employment opportunities	• Direct and indirect employment created by the project. • Longevity / certainty of employment for existing employees and indirect employment. • Redistribution of employment patterns – ie mining attracting people due to higher wages whereas other sectors may not have this advantage. • Increased trade in other services (ie accommodation, retail) resulting in additional employment opportunities.

Table 38 - Housing

Affect	Assessment Criteria
Impacts on existing housing stock will occur	• Increase in demand from FI/FO or DI/DO workers. • Increased demand for tenancies. • Increased / inflated housing costs making housing unaffordable for a larger cohort of the community. • Decrease in the availability of and access to affordable housing stock.

Table 39 – Community Infrastructure

Affect	Assessment Criteria
Additional utilisation of community infrastructure will occur (roads, community halls, child care facilities, sporting and recreation etc.)	• New services and facilities required ancillary to the project due to population increase arising from the project. • Increase in employee traffic to and from the site. • Ongoing use of existing services by existing workforce.

Table 40 – Community Support

Affect	Assessment Criteria
Additional support services will be required to meet the demands of any identified changes	New services and facilities required ancillary to the project due to population increase or decrease (in the case of mine closure).

Table 41 – Service Demand

Affect	Assessment Criteria
Existing support services will be utilised to an extent where they are unable to meet the demand	Ongoing use of existing services however demand increased as a result of mine closure.

Table 42 - Conflict

Affect	Assessment Criteria
The proposal is likely to cause conflict within the community (i.e. is not supported, or there is conflict between supporters and non-supporters)	- Visual impact caused by the location of infrastructure, lighting etc. - Change in environmental conditions (eg adverse noise and air quality impacts from the mines operations, changes to water quality and availability). - Transport noise caused by rail / trucks and employee movements.

Table 43 – Community Identity

Affect	Assessment Criteria
An impact on community identity is likely	- Change in population structure (ie relocation of landholders due to property purchase). - Change in land characteristics that prevent use, development and / or access to certain areas. - Change to the social amenity due to noise, air quality, visual etc.

Table 44 – Cultural Identity

Affect	Assessment Criteria
An impact on cultural identity is likely	• Loss of community / public access to certain areas. • Loss of or reduced access to sites of significance (indigenous and European) • Threat of a change in lifestyle for land holders. • New project proposed within an existing community

From this assessment it is found that the proposed modification to increase production and staffing will result in the following:

- No requirement to purchase property as a means of managing impact on social amenity.
- No adverse impact on surrounding land use or viability.
- No change to the social fabric of the area.
- No change to how residents or visitors utilise the area.
- No increased demand for local and regional infrastructure and services as an outcome for the modification.
- A positive impact on sustained employment due to the Project sustaining a workforce as a result of Newstan Colliery being placed in care and maintenance.

Assessment of potential impacts on local and regional communities

The generation of sustained and additional employment represents a positive social impact. A survey of the Centennial Coal's workforce has found that employees are more likely to own their own home and have worked in the industry for over 10 years. Employees and their families also contribute to the social economy via their participation in activities such as coaching junior sports, membership in service organisations such as the rural fire service, assistance in the school canteen, membership on their P & C, socialising, gym membership, mountain bike riding and bush walking etc.

Long term secure employment means that residents are more likely to purchase their home and participate in the social and financial economy of the area where they live. If however, there are ongoing and sustained job losses (or no surety of employment) people will potentially relocate and the social and economic contribution that they make will be lost.

The social benefits of staying in the community mean:

- Investment in housing.
- Long term planning for the future via education, family planning etc.
- Participation in social activities and maintenance of social ties.

- Long term planning by other businesses that rely on the sector (directly or indirectly).
- Investment and confidence by other industry sectors.
- Growth, rather than changing needs (i.e. an ageing community).

8.6.3 Mitigation and Management

This assessment has found that all assessment criteria is within compliance. If however issues do arise conventional strategies to address any concerns can be effectively implemented. In support of this, Myuna Colliery has an existing well-structured community engagement program in the form of a Stakeholder Engagement Plan that will be utilised for the proposed modification and continue for the life of the Project. This Stakeholder Engagement Plan is regularly reviewed to ensure that the information and mechanisms for providing that information to key community and government stakeholders are appropriate and any issues are responded to.

8.6.4 Conclusion

The potential social impacts of the proposed modification can be both positive and negative in nature. The assessment has found that the modification will result in the following:

- No requirement to purchase property as a means of managing impact on social amenity.
- No adverse impact on surrounding land use or viability.
- No change to the social fabric of the area.
- No change to how residents or visitors utilise the area.
- No increased demand for local and regional infrastructure and services as an outcome for the modification.
- A positive impact on sustained employment due to the Project sustaining a workforce as a result of Newstan Colliery being placed in care and maintenance.

Myuna Colliery will continue to operate as a good neighbour in the community and utilise existing strategies and programs implemented in the local area. CMPL currently contributes to the local community through various sponsorships and donations, including initiatives at a number of local schools, sporting clubs, community initiatives, and cultural associations. The potential social benefits of the proposed modification will result in ongoing and sustained employment which is found to bring a positive social and economic benefit to the community and region.

9 JUSTIFICATION AND CONCLUSION

9.1 Justification

Like other companies in the Australian (and global) mining sector, Centennial have continued to review its business operations in response to changing market conditions continuing to impact the industry. As a result, in August 2014 it became necessary to place the Newstan Colliery back into 'care and maintenance'. At the time Newstan Colliery employed 148 people. Centennial identified the ability to transfer workers from the Newstan Colliery to Myuna Colliery as a way to reduce the impact of job losses.

The additional workforce relocating to Myuna Colliery will result in the operation of additional mining equipment underground, consequently increasing the rate of production from the Myuna Colliery. The increase in production will assist in providing flexibility to Centennial in meeting local coal supply contracts that would have otherwise been provided through the ongoing operations at the Newstan Colliery.

The proposed modification to the Myuna Colliery Project Approval is within the existing operational constraints of the mine and associated existing infrastructure. No additional infrastructure is required to support the proposed modification and the proposed modification has no impact above those previously assessed and approved. If approved, the Myuna Colliery will provide for the ongoing employment of up to 300 people who contribute to the local economy of Lake Macquarie and Wyong

9.2 Conclusion

CMPL are seeking to modify Project Approval 10_0080 pursuant to Section 75W of Part 3A of the EP&A Act to allow for:

- an increase in coal extraction to not more than 3 million tonnes per annum; and
- increase employment to 300 full time employees.

The proposed modification has been assessed using a risk-based approach to appropriately identify and assess potential environmental impacts. Emphasis has been placed on ensuring minimal changes to the approved operations at the Myuna Colliery. In particular, the proposed modification will not result in any changes to the approved life of the mine, mining method, coal handling, coal transportation, water management or reject management at the Myuna Colliery.

Impacts associated with the proposed modification have been assessed in the EA with the conclusion that the proposed modification will have no environmental consequences beyond those already approved pursuant to Project Approval 10_0080. The Myuna Colliery EMS provides sufficient environmental controls to cater for the proposed modification.

The proposed modification is considered to be consistent with relevant objectives of the EP&A Act and will not change the nature of the development originally approved. On considering the balance of environment and community impacts, it is considered reasonable to conclude that the benefits of the proposed modification outweigh the impacts.

10 REFERENCES

- AECOM Australia Pty Ltd (2011), *Myuna Colliery Extension of Mining – Environmental Assessment*.
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- Intersect Traffic (2014), *Traffic Impact Assessment – Myuna Colliery Production Increase*.
- NPWS (2005), *Lake Macquarie State Conservation Area, Pulbah Island Nature Reserve and Moon Island Nature Reserve Plan of Management*.
- SLR Consulting Australia Pty Ltd (2014), *Myuna Colliery Modification - Air Quality Impact Assessment*.

11 ABBREVIATIONS

AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment Conservation Council
Banpu	Banpu Public Company Limited
CCC	Community Consultative Committee
Centennial	Centennial Coal Company Limited
CHP	Coal Handling Plant
CMPL	Centennial Myuna Pty Limited
DP&E	Department of Planning and Environment
EA	Environmental Assessment
EL	Exploration Licence
EMS	Environmental Management System
EPA	Environmental Protection Authority
EP&A Act	Environmental Planning and Assessment Act 1979
EPI	Environmental Planning Instrument
EPL	Environmental Protection Licence
GDE	Groundwater Dependent Ecosystem
GHG	Greenhouse Gas
Heritage Act	Heritage Act 1977
HUA WSP	Hunter Unregulated and Alluvial Water Sources Water Sharing Plan
ILUA	Indigenous Land Use Agreement
LEP	Local Environment Plan
LGA	Local Government Area
LMCC	Lake Macquarie City Council
LOS	Levels of Service
Mining SEPP	State Environmental Planning Policy (Mining, Petroleum Production & Extractive Industries) 2007
ML	Mining Lease
MNES	Matters of National Environmental Significance

MSC Act	Mine Subsidence Compensation Act 1961
Mtpa	Million tonnes per annum
NEPC	National Environment Protection Council
NGER Act	National Greenhouse and Energy Reporting Act 2007
NHMRC	National Health and Medical Research Council
NOW	NSW Office of Water
NP&W Act	National Parks and Wildlife Act 1974
NPWS	National Parks and Wildlife Service
NSW	New South Wales
POEO Act	Protection of the Environment Operations Act 1997
RMS	Roads and Maritime Service
ROM	Run of Mine
SIA	Social Impact Assessment
TSC Act	Threatened Species Conservation Act 1995
TSP	Total Suspended Particulates
t/year	Tonnes per year
WHO	World Health Organisation
WM Act	Water Management Act 2000
WSP	Water Sharing Plan

Appendix A – Correspondence with the Department of Planning and Environment



Myuna Colliery - Proposed Modification

Colin Phillips to: James Wearne

Cc: Howard Reed, Sophie Butcher

08/08/2014 08:46 AM

History:

This message has been replied to and forwarded.

Dear James,

I refer to your letter, dated 4 August 2014, about Centennial's proposal to seek approval to increase production at Myuna Colliery from 2 to 3 million tonnes per annum (Mtpa) and to increase in the mine's workforce from 210 to 300 personnel. Howard Reed has asked that I reply to your letter.

The Department requires that the Environmental Assessment (EA) to accompany the proposed modification application must address the following matters:

1. A full description of the proposed modification and a comparison to existing approved operations at the mine, setting out the manner in which the mine's existing infrastructure would be able to accommodate the proposed increased coal production and workforce;
2. A consideration of the statutory framework for the proposed modification including justification of the use of Section 75W;
3. A description of the consultation undertaken by the company with government agencies and the local community during the preparation of the EA;
4. A full description of the potential impacts of the proposal and any measures that the company would undertake (where relevant) to avoid, mitigate or offset these impacts, including:
 - a) a Traffic Impact Assessment addressing increased traffic generated by the increased number of employees and any additional heavy vehicle movements associated with the proposal;
 - b) a revised Air Quality Impact Assessment that models the effects of the increase in coal movements on the site and any relevant changes to surface activities or changes to mine ventilation volumes;
 - c) a desk top review of existing noise modelling;
 - d) a desk top review of existing groundwater studies;
 - e) a review of impacts of groundwater discharges to local water ways, and in particular, Lake Macquarie;
 - f) an assessment of socio-economic impacts attributable to the proposed increase coal production and employment at the mine.

The Department understands that the proposed modification would not require any ground disturbance at the site of the mine's surface facilities, such as an expansion of car-parking facilities, sewage management, supplementary surface water management or the installation of any additional ancillary surface infrastructure. Should this understanding be incorrect, you must contact the Department immediately to enable the reconsideration of matters required to be addressed in the EA.

Please contact me if you have any questions.

Appendix B – Traffic Impact Assessment (Intersect Traffic 2014)



TRAFFIC IMPACT ASSESSMENT

MYUNA COLLIERY PRODUCTION INCREASE

PREPARED FOR: CENTENNIAL MYUNA PTY LIMITED

OCTOBER 2014

REF: 14/054

**TRAFFIC IMPACT ASSESSMENT
MYUNA COLLIERY PRODUCTION INCREASE
CENTENNIAL MYUNA PTY LIMITED**

Intersect Traffic Pty Ltd (ABN: 43 112 606 952)

Address:

Shop 7, Metford Shopping Village
Cnr Chelmsford Drive & Tennyson Street,
Metford NSW 2323
PO Box 268
East Maitland NSW 2323

Contact:

(Ph) 02 4936 6200
(Mob) 0423 324 188
email: jeff@intersecttraffic.com.au

QUALITY ASSURANCE

This document has been prepared, checked and released in accordance with the Quality Control Standards established by Intersect Traffic Pty Ltd.

Issue	Date	Description	By
A	21/07/14	Draft	DD
B	22/07/14	Edit	JG
C	28/07/14	Proof	TB
D	16/10/14	Client Amendments	JG
E	16/10/14	Approved	JG

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This document has been authorised by


Date 16th October 2014**Disclaimer**

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EXECUTIVE SUMMARY

Intersect Traffic Pty Ltd (Intersect) has been engaged by Centennial Myuna Pty Ltd (Centennial Myuna) to undertake a Traffic Impact Assessment (TIA) for an increase in production from its existing Myuna Colliery at Wangi Wangi, New South Wales.

Myuna Colliery is an existing underground coal mine owned and operated by Centennial Myuna Pty Limited (Centennial Myuna), a wholly owned subsidiary of Centennial Coal Company (Centennial). Myuna Colliery's Surface Facilities Area is on the western side of Lake Macquarie at Wangi Wangi, approximately 25 kilometres south-west of Newcastle, NSW.

In 2012, Centennial Myuna received project approval for the continuation of mining until 31 December 2032 with part of the approval being the production, handling and distribution of up to 2 Mtpa of coal to Eraring Power Station.

Centennial Myuna is seeking to modify their consent to:

- ◆ Increase the maximum volume of coal extracted, processed and handled at the Myuna Colliery from 2 Mtpa to 3 Mtpa; and
- ◆ Increase the number of full time personnel working at the Myuna Colliery from 210 to 300.

An application under Section 75W of the Environmental Planning and Assessment Act is required to be made to NSW Planning and Environment supported by an Environmental Assessment which will include this TIA as supporting documentation.

This traffic assessment of the Myuna Colliery proposal to increase output to 3 Mtpa has determined the following;

- ◆ The local road network likely to be impacted on by the proposal is Summerhill Drive, Wangi Road and Donnelly Road.

- ◆ The current **local** road network (Summerhill Drive & Donnelly Road) around the site is typically two lane two way rural and urban roads with a likely desirable road network capacity of up to 650 vph (LOS C or better).
- ◆ Traffic data collected on the **local** road network indicates that Summerhill Drive and Donnelly Road have spare midblock capacity to cater for additional traffic generated by the proposal.
- ◆ The peak traffic generation period associated with Myuna Colliery will occur during shift changes between day shift and afternoon shift at 2.30 pm.
- ◆ Based on existing traffic generation rates and advice from the client that staff numbers will increase by up to 38 persons for the day shift and 22 persons for the afternoon shift (i.e. total 60 additional staff during the peak period change of shifts) it has been determined the likely additional peak hour traffic generated by the proposal is approximately 60 vtph.
- ◆ 90 % of all traffic generated by Myuna Colliery enters or leaves the site from/to the west i.e. during the critical PM peak hour period.
- ◆ The increase in traffic on the local road network will not cause the mid-block capacity of the **local** road network to be reached therefore subject to satisfactory intersection operation the proposal will not adversely impact on the local road network.
- ◆ Sidra modeling of the Myuna Colliery entrance at the intersection of Summerhill Drive and Wangi Point Road has determined that it will continue to operate satisfactorily after the proposed staff increases. The LOS for each turning movement is good (LOS A) and there is little if any delay for motorists.
- ◆ Sidra modeling of the Summerhill Drive / Wangi Road and the Donnelly Road / Wangi Road intersection has determined that they will continue to operate satisfactorily after the proposed staff increases. The LOS for each turning movement is good (LOS A) and there is little if any delay for motorists.
- ◆ The existing Myuna Colliery vehicular entrance intersection (Summerhill Drive / Wangi Point Road) has satisfactory sight distance therefore does not require modification as a result of this application.
- ◆ By observation it is considered that Summerhill Drive, Wangi Road and Donnelly Road are of a standard suitable for existing and future traffic generated by Myuna Colliery.
- ◆ The application will not result in any on-street car parking occurring in the vicinity of the site as a result of any additional parking demand during peak periods. As a result the proposal will not impact on the safety and efficiency of the public road network due to an increased on-street parking demand. On-site parking is an internal traffic management issue for Centennial Myuna who if required may need to provide additional overflow parking for the major shift change although car-pooling and varying arrival / departure times should see the existing under-utilised car park performing satisfactorily with the aide of overflow parking areas.
- ◆ Myuna Colliery is not currently serviced by public transport nor are there any pedestrian and bicycle facilities linking the site to nearby services and facilities. As a result there is very little if any dependence by employees on alternate transport modes to access the site. Whilst the proposal will generate additional employees it is not considered that the demand for alternate transport modes will be enough to warrant the extension of public transport and pedestrian / bicycle infrastructure to the site.
- ◆ The transportation of coal associated with Myuna Colliery is via alternate transport modes and will not impact on the adjacent public road network.

Having carried out this traffic impact assessment for the proposed increase in output from the Myuna Colliery it is recommended that the proposal can be supported as it will not adversely impact on the local road network.

ABBREVIATIONS

CHR – Channelised Right Turn

CHL – Channelised Left Turn

DGP – Development Control Plan

EL – Exploration Licence

Intersect Traffic – Intersect Traffic Pty Ltd.

TIA – Traffic Impact Assessment

AADT – Annual Average Daily Traffic

ADT - Average Daily Traffic

LOS – Level of Service

Mtpa – Million tonnes per annum

RMS – NSW Roads and Maritime Services

ROM – Run of mine

SISD – Safe Intersection Sight Distance

vph – vehicles per hour

vtpH – vehicle trips per hour

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1. INTRODUCTION

Intersect Traffic Pty Ltd (Intersect) has been engaged by Centennial Myuna Pty Ltd (Centennial Myuna) to undertake a Traffic Impact Assessment (TIA) for an increase in output from its existing Myuna Colliery at Wangi Wangi, New South Wales.

In 2012, Centennial Myuna received project approval for the continuation of mining until 31 December 2032 with part of the approval being the production, handling and distribution of up to 2 Mtpa of coal to Eraring Power Station.

Centennial Myuna is seeking to modify their consent to:

- ◆ Increase the maximum volume of coal extracted, processed and handled at the Myuna Colliery from 2 Mtpa to 3 Mtpa; and
- ◆ Increase the number of full time personnel working at the Myuna Colliery from 210 to 300.

An application under Section 75W of the Environmental Planning and Assessment Act is required to be made to NSW Planning and Environment supported by an Environmental Assessment which will include a TIA as supporting documentation.

This report presents the findings of the TIA and includes the following:

- ◆ An outline of the existing road network in the vicinity of the proposed development.
- ◆ An assessment of the likely additional peak traffic generation from the development.
- ◆ An assessment of the likely traffic impacts of the proposal on the adjacent road network in particular in regard to the safety and capacity of the existing road network.
- ◆ An assessment of the proposed access and on-site parking arrangements.
- ◆ An assessment of the impact on alternate transport mode services and facilities in the vicinity of the site.
- ◆ Presentation of conclusions and any recommendations.

This TIA has been carried out with reference to:

- ◆ RMS's Guide to Traffic Generating Developments - 2002;
- ◆ Austroads Guide to Road Design (2009);
- ◆ Lake Macquarie City Council's Development Control Plan Number 1 Principles of Development (Part 2.6 Transport, Parking, Access and Servicing), (DCP); and
- ◆ Information provided by Centennial Myuna.



2. SITE LOCATION

Myuna Colliery is an existing underground coal mine located in Wangi Wangi, Lake Macquarie in the Newcastle Coalfields approximately 25 kilometres south-west of Newcastle.

Myuna Colliery is bounded by Wangi Road, Summerhill Drive and Donnelly Road. Myuna Colliery is accessed by a private road (Wangi Point Road) which intersects with Summerhill Drive. Summerhill Drive connects to Donnelly Drive (via The Promenade) and Wangi Road to the north-west.

The Project Application Area of the TIA comprises the existing Myuna Colliery access site encompassing the car parking facilities and the surrounding road network. The Myuna Mine Access Site is accessed off Summerhill Drive to the north-west of the township of Wangi Wangi.

Figure 1 shows the Myuna Colliery Project Area.

Figure 2 shows the existing location of Myuna Colliery in relation to Wangi Wangi.

Figure 3 shows the existing Myuna Colliery surface layout.



AECOM

PROPOSED PROJECT AREA AND SUBSIDENCE ZONES
Environmental Assessment

Figure 1 – Myuna Colliery Project Area



Figure 2 –Myuna Mine Site Location

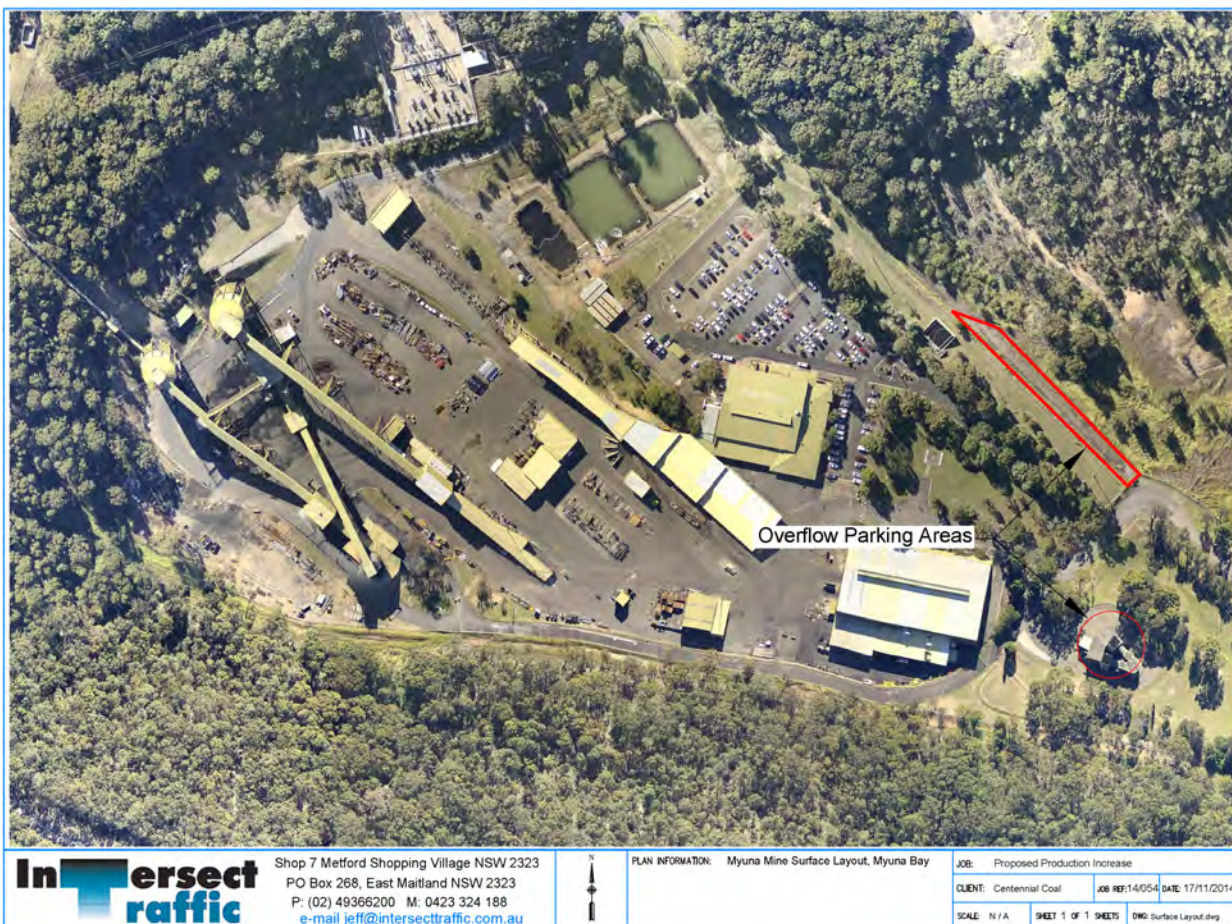


Figure 3 –Myuna Mine Surface Layout

3. DEVELOPMENT PROPOSAL

Myuna Colliery produces coal that is conveyed from the underground workings to the Coal Handling Plant at the Myuna Colliery Surface Facilities Area. Product coal is then transported directly by the Eraring Energy owned Enclosed Overland Conveyor to Eraring Power Station. No coal is transported by via the local road network. Therefore, this report focuses on the impact of employee vehicles on the surrounding road network and the existing car park facilities associated with Myuna Colliery.

Shifts at the mine generally operate between the following hours:

- ◆ Day shift - 6.30am to 2.30pm;
- ◆ Afternoon shift - 2.30pm to 10.30pm; and
- ◆ Night shift - 10.30pm to 6.30am.

The number of employees currently operating per shift is provided in **Table 1**.

Table 1 – Existing Employees per shift.

Shift Time	Number of Employees
Day Shift	112
Afternoon Shift	58
Night Shift	53
Total	223

Source: Centennial Myuna

Centennial Myuna is seeking to modify their operations to:

- ◆ Increase the maximum volume of coal extracted, processed and handled at the Myuna Colliery from 2 Mtpa to 3 Mtpa; and
- ◆ Increase the number of full time personnel working at the Myuna Colliery to 300.

Table 2 below provides the proposed distribution for each shift.

Table 2 – Proposed Employees per shift.

Shift Time	Number of Employees
Day Shift	150
Afternoon Shift	80
Night Shift	70
Total	300

Source: Centennial Myuna

As a result of this proposed increase in employees there will be an associated impact on the adjacent road network and existing parking area therefore Centennial Myuna require a TIA to support the Section 75W application under the Environmental Planning and Assessment Act to NSW Planning and Environment.

4. EXISTING ROAD NETWORK

The external road network likely to be impacted by the proposal will be;

- ◆ Summerhill Drive from Wangi Road to Dobell Drive;
- ◆ Dobell Drive from Summerhill Drive to Donnelly Road;
- ◆ Donnelly Road from Dobell Drive to Wangi Road; and
- ◆ Wangi Road from Donnelly Road to Summerhill Drive.

Figure 5 below shows the local road network assessed in this report.

The focal intersections on the surrounding road network that will be impacted on by additional traffic, as identified in the *AECOM Australia Pty Ltd TIA (October 2010)* supporting the most recent approval at Myuna Colliery, are:

- ◆ Summerhill Drive / Wangi Point Road (access to Myuna Colliery);
- ◆ Summerhill Drive / Wangi Road; and
- ◆ Donnelly Road / Wangi Road.

The peak traffic generating periods for the mine operations are likely to occur when day shift changes to afternoon shift at 2.30pm. This period is also likely to coincide with relatively busy periods on the local road network and is therefore considered to be the critical period for assessment.

Intersect Traffic has undertaken manual traffic counts at these focal intersections between 2.00pm and 3.30pm to obtain peak hour traffic volumes.

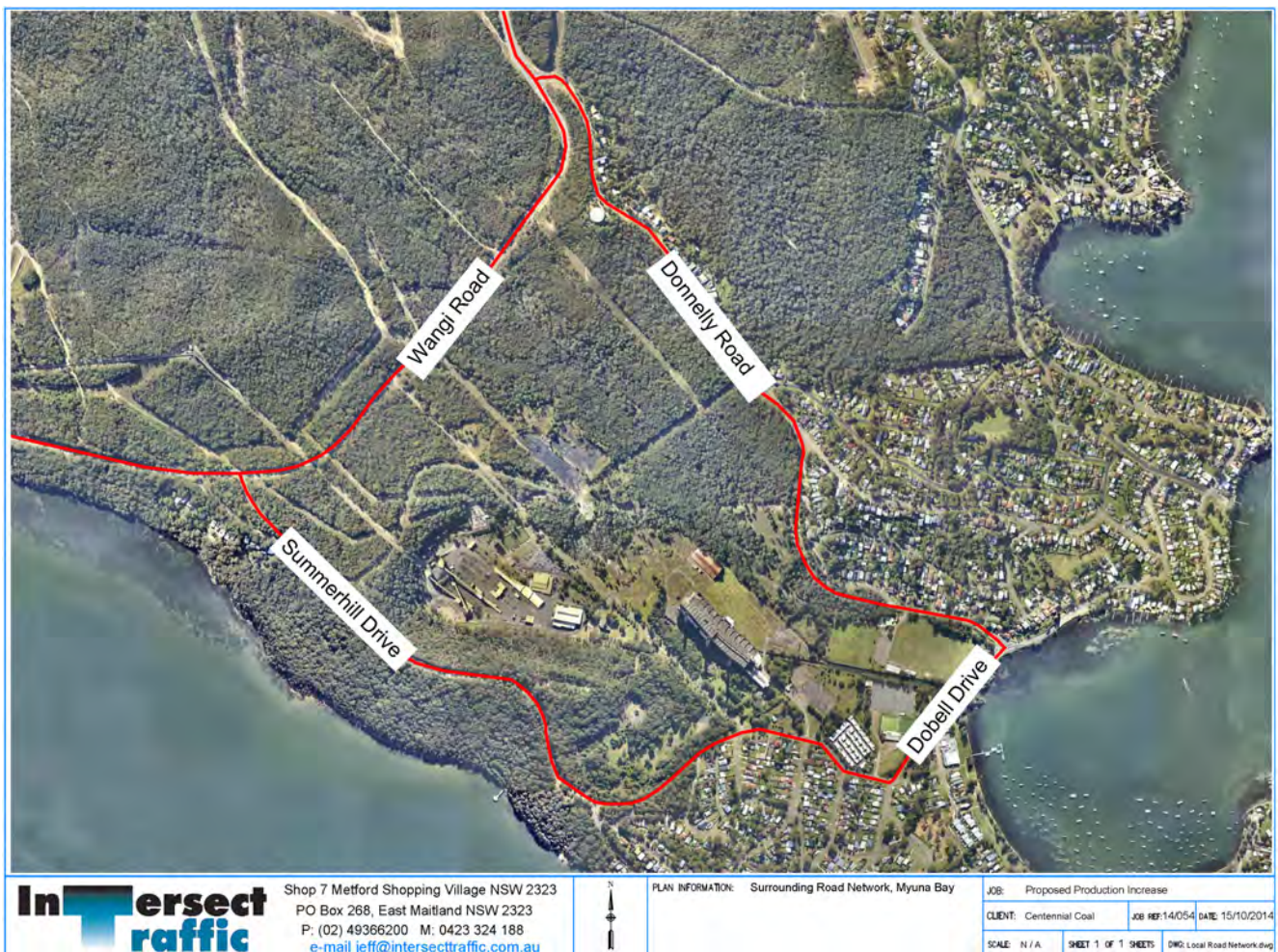


Figure 4 – Surrounding Road Network

4.1 Summerhill Drive

Summerhill Drive is a two way two lane urban road from Dobell Drive to Wangi Point Road and a two way two lane rural road from Wangi Point Road to Wangi Road that connects the Wangi Wangi area to Wangi Road and hence to the M1 Motorway. Under a functional road hierarchy this road performs as a minor collector road in that it collects traffic from a number of tributary local access roads and distributes traffic to the main arterial road network.

As a local road it is under the care and control of Lake Macquarie City Council and at the time of inspection was in fair condition. Summerhill Drive is speed zoned 50 km/h between Dobell Drive and Wangi Point Road and 80 km/h between Wangi Point Road and Wangi Road.

Photograph 1 below shows Summerhill Drive in the vicinity of Wangi point Road.



Photograph 1 – Summerhill Drive at Wangi Point Road

4.2 Wangi Point Road - Myuna Colliery Mine Access

The existing Myuna Mine Access is via Wangi Point Road and connects to Summerhill Drive. Wangi Point Road is a **private road** under the care and control of Myuna Centennial.

The intersection with Summerhill Drive is constructed as an urban intersection with Give Way conditions applying to the Wangi Point Road leg. At the time of inspection the road surface was in reasonable condition with a 50 km/h speed limit applying from Summerhill Drive to the main entry to the Colliery. A 20 km/h speed limit applies within the Colliery site.

Photograph 2 below shows Wangi Point Road in the vicinity of the Myuna Colliery Access.



Photograph 2 – Wangi Point Road – Myuna Colliery Access

4.3 Donnelly Road

Donnelly Road is a local collector road that provides a secondary connection from Myuna Colliery to Wangi Road via Dobell Drive and then to Wangi Road. In the vicinity of Dobell Drive it is a two way two lane road with varying speed limits between 50 km/h and 70 km/h and at the time of inspection was in reasonable condition.

Photograph 3 below shows Donnelly Road in the vicinity of Dobell Drive.



Photograph 3– Donnelly Road in the vicinity of Dobell Drive

4.4 Wangi Road.

Wangi Road connects the townships of Dora Creek to the south-west and Toronto to the north-east. It is a two way two lane road in each direction for the majority of its length. To the north-east of Summerhill Drive the northbound and southbound lanes of Wangi Road alternate between one and two lanes in each direction. Wangi Road has a speed limit of 90 km/h and is a State Road under the care and control of the RMS.

Photograph 4 below shows Wangi Road in the vicinity of Summerhill Drive.



Photograph 4 – Wangi Road in the vicinity of Summerhill Drive.

5. TRAFFIC VOLUMES AND NETWORK CAPACITY

As part of the TIA traffic volumes (AADT and ADT) were sourced from the following:

- ◆ Myuna Colliery Extension of Mining TIA completed by AECOM in October 2010; and
- ◆ Intersect Traffic manual intersection counts completed in June and July 2014.

5.1 AECOM TIA 2010.

Below is an extract from the AECOM 2010 TIA which provides traffic data sourced by AECOM that is still considered relevant.

Table 2.1: Historical traffic volumes

Count Station	Road	Location	AADT (2005)
1	Donnelly Road	Between Alexander Parade and Arcadia Street	3,167
2	Donnelly Road	Between Arcadia Street and House no 95	3,276
3	Donnelly Road	Between House no 95 and Wangi Road	3,410
4	Summerhill Drive	Between Wangi Road and Boundary Road	2,123
5	Summerhill Drive	Between Boundary Road and Dobell Drive	1,708

Source: Lake Macquarie City Council, 2005

The nearest RTA permanent count station in the vicinity of proposed Project is located on Wangi Road at Wangi Creek Bridge. **Table 2.2** and **Figure 2.6** show historical AADT at this station and the associated historical growth rate.

Table 2.2: Historical traffic volumes and growth

Road	Location	AADT				
		1995	1998	2001	2004	% annual growth
Wangi Road	Wangi Creek Bridge	7,211	7,531	8,514	8,728	2.1%

Source: RTA, 2004

Based on the data above, the average annual growth rate in the area between 1995 and 2004 was 2.1%.

Using the growth rate identified in **Table 2.2**, existing (2010) and future (2031) AADT data has been calculated at each count location and is shown in **Table 2.3**. 2031 has been chosen as this is the life span of Myuna Colliery for which approval is being sought. The traffic volumes for 2010 and 2031 are considered to be a conservative scenario as the growth rate applied (to the local roads in the vicinity of the site as well as Wangi Road) has been derived from counts on Wangi Road which connects townships, as opposed to local roads within townships.

Table 2.3: Existing and future traffic volumes

Count Station	Road	Location	AADT		
			2005	2010	2031
1	Donnelly Road	Between Alexander Parade and Arcadia Street	3,167	3,521	5,498
2	Donnelly Road	Between Arcadia Street and House no 95	3,276	3,643	5,687
3	Donnelly Road	Between House no 95 and Wangi Road	3,410	3,792	5,920
4	Summerhill Drive	Between Wangi Road and Boundary Road	2,123	2,361	3,685
5	Summerhill Drive	Between Boundary Road and Dobell Drive	1,708	1,899	2,965
RTA count station	Wangi Road	Wangi Creek Bridge	8,728 (2004)	9,913	15,476

Source: AECOM, RTA, LMCC, 2010

5.2 Intersect Traffic data.

Over the period of the mining operation (to 2031) the traffic volumes associated with Myuna Colliery will not increase after application of the additional employees vehicle movements. What will increase are the background traffic volumes which are associated with normal growth due to increase population and development. This proposal by Myuna Centennial does not involve additional development and is utilising the existing infrastructure. It also does not involve construction equipment so the traffic generation from the site once the additional employee traffic is added will in theory remain stagnant until mining ceases in 2031.

Therefore 2014 / 2015 are the critical years during which time employees are engaged and the traffic surveys undertaken by Intersect Traffic are considered the most relevant to the application.

Intersect Traffic completed three (3) peak hour movement surveys between 2 pm and 3.30 pm at the following times and locations to permit analysis using the Sidra Intersection model:

- ◆ 24/6/14 – Summerhill Drive / Wangi Point Road intersection;
- ◆ 14/7/14 – Wangi Road / Donnelly Road; and
- ◆ 15/7/14 – Wangi Road / Summerhill Drive

The results of these peak hour surveys for each movement are summarised below in **Table 3**.

Table 4 summaries the existing traffic for each leg at each intersection and provides a total volume for each road.

Table 3 – Existing PM Peak Hour Turn Movements (Intersect)

Intersection	Approach	Peak	Turn	Traffic Volume (vtp/h)
Summerhill Dr / Wangi Point Rd	Summerhill Dr west	PM	L	22
		PM	T	62
	Wangi Point Rd	PM	L	13
		PM	R	37
	Summerhill Dr east	PM	T	66
		PM	R	10
Wangi Rd / Donnelly Road	Wangi Rd west	PM	L	160
		PM	T	323
	Donnelly Rd	PM	L	11
		PM	R	133
	Wangi Rd east	PM	T	327
		PM	R	11
Wangi Rd / Summerhill Dr	Wangi Rd west	PM	T	164
		PM	R	38
	Summerhill Rd	PM	L	22
		PM	R	38
	Wangi Rd east	PM	L	13
		PM	T	180

Table 4 – Existing PM Traffic Volume Data (Intersect)

Intersection	Approach	Volume (vtp/h)	Total (vtp/h)
Summerhill Dr / Wangi Point Rd	Summerhill Dr west	187	
	Summerhill Dr east	151	338
	Wangi Point Rd	82	82
Wangi Rd / Donnelly Road	Wangi Rd west	943	
	Wangi Rd east	672	1615
	Donnelly Rd	315	315
Wangi Rd / Summerhill Dr	Wangi Rd west	404	
	Wangi Rd east	395	799
	Summerhill Rd	111	111

The capacity of urban and rural roads is generally governed by the capacity of intersections on the road network however Table 4.5 of the RMS' *Guide to Traffic Generating Developments* gives some guidance on the mid-block capacity and expected levels of service (LOS) on rural roads. This table is reproduced below. The RMS' *Guide to Traffic Generating Developments* also provides the following definitions for level of service A to F.

Level of Service A.

This, the top level is a condition of free flow in which individual drivers are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to manoeuvre within the traffic stream is extremely high, and the general level of comfort and convenience provided is excellent.

Level of Service B.

This level is in the zone of stable flow and drivers still have reasonable freedom to select their desired speed and to manoeuvre within the traffic stream, although the general level of comfort and convenience is little less than that of the level of Service A.

Level of Service C.

This service level is also in the zone of stable flow, but most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience declines noticeably at this level.

Level of Service D.

This level is close to the limit of stable flow but is approaching unstable flow. All drivers are severely restricted in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is poor, and small increases in traffic flow will generally cause operational problems.

Level of Service E.

This occurs when traffic volumes are at or close to capacity and there is virtually no freedom to select desired speeds or to manoeuvre within the traffic stream. Flow is unstable and minor disturbances within the traffic stream will cause a traffic-jam.

Level of Service F.

This service level is in the zone of forced flow. With it, the amount of traffic approaching the point under consideration exceeds that which can pass it. Flow break-down occurs and queuing and delays result

Table 4.5
peak hour flow on two-lane rural roads (veh/hr)
(Design speed of 100km/hr)

Terrain	Level of Service	Percent of Heavy Vehicles			
		0	5	10	15
Level	B	630	590	560	530
	C	1030	970	920	870
	D	1630	1550	1480	1410
	E	2630	2500	2390	2290
Rolling	B	500	420	360	310
	C	920	760	650	570
	D	1370	1140	970	700
	E	2420	2000	1720	1510
Mountainous	B	340	230	180	150
	C	600	410	320	260
	D	1050	680	500	400
	E	2160	1400	1040	820

The data for Table 4.5 assumes the following criteria:

- *terrain level* with 20% no overtaking.
- *rolling* with 40% no overtaking.
- *mountainous* with 60% no overtaking.
- 3.7 m traffic lane width with side clearances of at least 2m.
- 60/40 directional split of traffic.

It is noted that the table provides for speed limits of 100 km/h and does not indicate how a different design speed affects the capacity levels. As the speed limits on the subject local road network vary from 90 km/h to 70 km/h the volumes above are considered satisfactory as a guide only to the proposed LOS. Assuming a 100 km/h design speed, 10 % heavy vehicles and rolling terrain the likely LOS thresholds on the rural road network being assessed would be as shown in **Table 5** below.

Table 5 – Likely Level of Service thresholds

Level of Service	Traffic volume (vph)
B	360
C	650
D	970
E	1720

Therefore given current traffic volumes (**Table 4**) it can be seen that the local road network currently operates with the following Levels of Service.

Table 6 – Current Estimated Levels of Service – local road network

Road	Level of Service
Summerhill Dr	A
Donnelly Rd	A

Wangi Road is not included as the function of the road would be more as a sub-arterial or even an arterial road where high traffic volumes exist. Observation at the time of inspection indicated that the road was operating well within capacity with little or no delay or congestion.

If it is assumed that a desirable level of service C or better on the local rural road network (Summerhill Drive & Donnelly Road) during the weekday peak is considered satisfactory as recommended in the RMS' *Guide to Traffic Generating Developments* then this data indicates that the local road network has significant spare capacity to cater for the additional traffic generated by this project.

6. TRAFFIC GENERATION AND DISTRIBUTION

Intersect Traffic carried out manual traffic counts at the Myuna Colliery access (Wangi Point Road / Summerhill Road intersection) during the major shift change at the site being 2.30 pm for the commencement of the afternoon shift and 3 pm for the completion of the day shift. This data (**Table 3**) will provide the necessary traffic generation and trip distribution data required to carry out this traffic assessment.

Traffic Generation

Existing shift numbers and proposed shift numbers have been provided by Myuna Centennial and included in **Tables 1 & 2** (see **Section 3**).

The critical impact period has been identified as the change from day shift to afternoon shift. This relates to an increase of **38** vehicles leaving the site from day shift and **22** vehicles entering the site for the afternoon shift (total = 60) assuming no car-pooling occurs.

Proposed Trip Distribution of additional employees

Based on the trip distribution percentage measured at the intersection of Summerhill Drive and Wangi Point Road the additional trips have been assigned to Summerhill Drive as shown in **Table 7** below:

Table 7 – Trip Distribution at Summerhill Drive / Wangi Point Road.

Intersection	Approach	Peak	Turn	Traffic Volume (vtph)
Summerhill Dr / Wangi Point Rd	Summerhill Dr west	PM	L	15
		PM	T	
	Wangi Point Rd	PM	L	9
		PM	R	29
	Summerhill Dr east	PM	T	
		PM	R	7
TOTAL				60

Based on the distribution in **Table 7** above arrivals and departures for proposed traffic at the Wangi Road / Summerhill Road and Wangi Road / Donnelly Road intersections have been calculated and are shown in **Table 8** below:

Table 8– Trip Distribution at Wangi Road / Summerhill Drive & Wangi Road / Donnelly Road.

Intersection	Approach	Peak	Turn	Traffic Volume (vtph)
Wangi Rd / Donnelly Road	Wangi Rd west	PM	L	6
		PM	T	
	Donnelly Rd	PM	L	1
		PM	R	14
	Wangi Rd east	PM	T	
		PM	R	1
Wangi Rd / Summerhill Dr	Wangi Rd west	PM	T	
		PM	R	7
	Summerhill Rd	PM	L	9
		PM	R	29
	Wangi Rd east	PM	L	15
		PM	T	

Total Trip Distribution for existing and additional employees

Table 9 below provides the combined arrivals and departures at the three focus intersections.

Table 9 – Total Trip Distribution

Intersection	Approach	Peak	Turn	Traffic Volume (vtp/h)
Summerhill Dr / Wangi Point Rd	Summerhill Dr west	PM	L	37
		PM	T	62
	Wangi Point Rd	PM	L	22
		PM	R	66
	Summerhill Dr east	PM	T	66
		PM	R	17
Wangi Rd / Donnelly Road	Wangi Rd west	PM	L	166
		PM	T	323
	Donnelly Rd	PM	L	12
		PM	R	147
	Wangi Rd east	PM	T	327
		PM	R	12
Wangi Rd / Summerhill Dr	Wangi Rd west	PM	T	164
		PM	R	53
	Summerhill Rd	PM	L	28
		PM	R	54
	Wangi Rd east	PM	L	20
		PM	T	180

Note: Assessment has also included the following assumptions;

- ◆ No allowance has been made for car pooling; and
- ◆ No allowance has been made for local trips into the adjoining urban areas from Donnelly Road.



7. TRAFFIC AND TRANSPORT IMPACTS

Sidra modelling has been carried out using the level of service (delay) model adopted by the RMS in NSW. Average delay is used to determine the level of service (LOS) based on the following table sourced from the RMS' *Guide to Traffic Generating Developments*.

Table 4.2
Level of service criteria for intersections

Level of Service	Average Delay per Vehicle (secs/veh)	Traffic Signals, Roundabout	Give Way & Stop Signs
A	< 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays & spare capacity	Acceptable delays & spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity & accident study required
E	57 to 70	At capacity; at signals, incidents will cause excessive delays Roundabouts require other control mode	At capacity, requires other control mode

For assessment purposes a LOS D or higher is considered satisfactory intersection operation.

A summary table for each of the modelled intersections showing existing and post-employment analysis is provided and the Sidra Movement Tables are included in **Appendix 2**.

The results of this modelling are shown in the following tables.

7.1 Summerhill Drive / Wangi Point Road Intersection

Table 10 – Summerhill Drive / Wangi Point Road - Sidra Model Movement Summary Sheets

Scenario	Deg Satn.	Average Delay	Level of Service	95% Back of Queue (m)
Existing	0.047	2.4 s	A	1.6
With Development	0.078	3.2 s	A	1.8

Comment

The intersection is operating well within capacity with a LOS of A with little or no delay for motorists. Therefore the additional employee traffic does not adversely impact on this intersection.

7.2 Wangi Road / Summerhill Drive Intersection

Table 11 – Wangi Road / Summerhill Drive - Sidra Model Movement Summary Sheets

Scenario	Deg Satn.	Average Delay	Level of Service	95% Back of Queue (m)
Existing	0.092	1.8 s	A	2.3
With Development	0.131	2.3 s	A	3.4

Comment

The intersection is operating well within capacity with a LOS of A with little or no delay for motorists. Therefore the additional employee traffic does not adversely impact on this intersection.

7.3 Wangi Road / Donnelly Road Intersection

Table 12 – Wangi Road / Donnelly Road - Sidra Model Movement Summary Sheets

Scenario	Deg Satn.	Average Delay	Level of Service	95% Back of Queue (m)
Existing	0.192	2.3 s	A	5.0
With Development	0.211	2.4 s	A	5.6

Comment

The intersection is operating well within capacity with a LOS of A with little or no delay for motorists. Therefore the additional employee traffic does not adversely impact on this intersection.



Photograph 5 – Myuna Colliery Access (Wangi Point Road) intersection with Summerhill Drive.

7.4 Road Safety

The road network impacted on by this proposal is from observation considered to be suitable to carry the increase in traffic volumes resulting from the Myuna Colliery Project.

There is sufficient sight distance at the intersections of Summerhill Drive / Wangi Point Road and Donnelly Road / Wangi Road to ensure there are no road safety impacts as a result of additional traffic generated by the proposal.

Sight distance to the north at the intersection of Summerhill Drive / Wangi Road is restricted under the existing situation, due to the crest of the hill at this location. However as the amount of additional traffic generated by this proposal is relatively minor compared to existing traffic volumes at the intersection this issue is not considered to be significant to the approval of the proposal.



Photograph 6 – Existing site distance at Summerhill Drive intersection with Wangi Road.

7.4 On-site Car Parking

The traffic counts carried out at the existing Myuna Colliery Site entrance has identified that the additional peak hour traffic volume generated by the proposal to increase output from the mine is of the order of 60 vehicles per hour at the afternoon change of shifts. It would be reasonable to assume that this would correlate to a peak on-site parking demand of 60 vehicles. On the same basis the existing on-site peak parking demand is estimated to be in the order of 170 vehicles based on the day and afternoon shift numbers.

Therefore the proposal to increase the output from Myuna Colliery is likely to increase the on-site car parking demand to 230 vehicles.

There is a significant on-site car parking area on-site and the capacity of this car park has been estimated using data from Australian Standard AS2890.1 Parking facilities Part 1: Off street car parking in regard to minimum parking bay dimensions.

The existing parking bays as identified in **Figure 6** below have been estimated to have capacities as shown in **Table 13** below:



Figure 5 – Existing Myuna Colliery car parking areas



Figure 6 – Existing Parking Bays.

Table 13 – Calculation of 2.4m wide existing parking bays

Bay number	Estimated length (m)	Estimated number of car parks
1	45	18
2	54.6	22
3	52.4	21
4	49.2	20
5	42.1	17
6	36.7	15
7	29.1	12
8	24.2	10
9	16.6	6
10	12.2	5
11	44.2	18
12	41.3	17
13	25	10
14	24.2	10
15	17.5	7
TOTAL		207 BAYS

Therefore the estimated number of on-site car parks is in the order of 207 therefore this calculation shows that the proposal to increase production from the Myuna Colliery could lead to a small shortage of on-site car parking. It should be noted car-pooling and slight variations in arrival and departure times for employees could reduce the car parking deficiency. It should also be noted the peak parking demand period is short coinciding with the arrival of the afternoon shift prior to the departure of the day shift from the site.

However the Myuna Colliery site is large and there are a number of areas that could be utilised for overflow car parking (see **Figure 5**) should the existing on-site car parking be deficient for the small period during the shift changeover.

Therefore it is considered the proposal will not result in any on-street car parking occurring in the vicinity of the Myuna Colliery that would impact on the safety and efficiency of the public road network. In this instance on-site car parking becomes an internal traffic management issue for Centennial Myuna who if required may need to construct some additional car parking bays.

8. ALTERNATE TRANSPORT MODES

The Myuna Colliery site is currently not serviced by public transport. The nearest public bus service provided by Hunter valley Buses operates as Route 275 and 276 on Dobell Drive which is approximately 400 metres from the intersection of Wangi Point Road and Summerhill Drive intersection (see **Figure 8** below). Similarly there are no rail services within convenient walking distance to the site.



Figure 7 – Existing Bus Service Route 275 & 276.

Given that the additional employee numbers per shift is not high and that the local road network is not nearing capacity thresholds the need to encourage public transport usage in this location is not critical. Therefore it is considered there is no real nexus to require the extension of public transport services to the site.

By observation there are no on or off road pedestrian and cycle way facilities in the vicinity of the Myuna Colliery. This means pedestrians and cyclists accessing the site would need to share the travel lanes on the local road network. It was also noted during the recent traffic counts that there was little if any pedestrian and bicycle traffic to and from the site. As there is little existing demand for these facilities and there is likely to be little if any additional demand from this proposal, no nexus exists for the provision of additional pedestrian and bicycle infrastructure linking the mine site to nearby facilities or services.

9. CONCLUSIONS

This traffic assessment of the Myuna Colliery proposal to increase output to 3 Mtpa has determined the following;

- ◆ The local road network likely to be impacted on by the proposal is Summerhill Drive, Wangi Road and Donnelly Road.
- ◆ The current **local** road network (Summerhill Drive & Donnelly Road) around the site is typically two lane two way rural and urban roads with a likely desirable road network capacity of up to 650 vph (LOS C or better).
- ◆ Traffic data collected on the **local** road network indicates that Summerhill Drive and Donnelly Road have spare midblock capacity to cater for additional traffic generated by the proposal.
- ◆ The peak traffic generation period associated with Myuna Colliery will occur during shift changes between day shift and afternoon shift at 2.30 pm.
- ◆ Based on existing traffic generation rates and advice from the client that staff numbers will increase by up to 38 persons for the day shift and 22 persons for the afternoon shift (i.e. total 60 additional staff during the peak period change of shifts) it has been determined the likely additional peak hour traffic generated by the proposal is approximately 60 vtph.
- ◆ 90 % of all traffic generated by Myuna Colliery enters or leaves the site from/to the west i.e. during the critical PM peak hour period.
- ◆ The increase in traffic on the local road network will not cause the mid-block capacity of the **local** road network to be reached therefore subject to satisfactory intersection operation the proposal will not adversely impact on the local road network.
- ◆ Sidra modeling of the Myuna Colliery entrance at the intersection of Summerhill Drive and Wangi Point Road has determined that it will continue to operate satisfactorily after the proposed staff increases. The LOS for each turning movement is good (LOS A) and there is little if any delay for motorists.
- ◆ Sidra modeling of the Summerhill Drive / Wangi Road and the Donnelly Road / Wangi Road intersection has determined that they will continue to operate satisfactorily after the proposed staff increases. The LOS for each turning movement is good (LOS A) and there is little if any delay for motorists.
- ◆ The existing Myuna Colliery vehicular entrance intersection (Summerhill Drive / Wangi Point Road) has satisfactory sight distance therefore does not require modification as a result of this application.
- ◆ By observation it is considered that Summerhill Drive, Wangi Road and Donnelly Road are of a standard suitable for existing and future traffic generated by Myuna Colliery.
- ◆ The application will not result in any on-street car parking occurring in the vicinity of the site as a result of any additional parking demand during peak periods. As a result the proposal will not impact on the safety and efficiency of the public road network due to an increased on-street parking demand. On-site parking is an internal traffic management issue for Centennial Myuna who if required may need to provide additional overflow parking for the major shift change although car-pooling and varying arrival / departure times should see the existing under-utilised car park performing satisfactorily with the aide of overflow parking areas.
- ◆ Myuna Colliery is not currently serviced by public transport nor are there any pedestrian and bicycle facilities linking the site to nearby services and facilities. As a result there is very little if any dependence by employees on alternate transport modes to access the site. Whilst the proposal will generate additional employees it is not considered that the demand for alternate transport modes will be enough to warrant the extension of public transport and pedestrian / bicycle infrastructure to the site.
- ◆ The transportation of coal associated with Myuna Colliery is via alternate transport modes and will not impact on the adjacent public road network.



10. RECOMMENDATIONS

Having carried out this traffic impact assessment for the proposed increase in output from the Myuna Colliery it is recommended that the proposal can be supported as it will not adversely impact on the local road network.

***JR Garry BE (Civil), Masters of Traffic
Director
Intersect Traffic Pty Ltd***

APPENDIX 1

MANUAL TRAFFIC COUNT SHEETS

Date	24/06/2014
Day	Tuesday
Time	2:00pm - 3:30pm
Weather	Fine
Conducted by:	Daniel



MOVEMENT	1	2	3	4	5	6
2:00 - 2:15	16	12	3	1	5	21
2:15 - 2:30	12	7	3	1	4	18
2:30 - 2:45	14	2	14	5	0	15
2:45 - 3:00	20	1	17	6	1	12
3:00 - 3:15	21	0	7	0	0	15
3:15 - 3:30	12	0	6	2	0	16

210

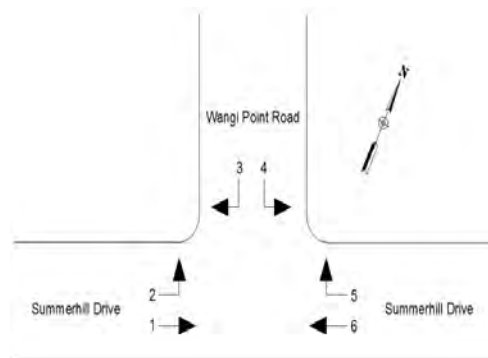
195

186

SUM	95	22	50	15	10	97
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PEAK	62	22	37	13	10	66
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Leg	PHT (vph)
Summerhill Drive West	187
Summerhill Drive East	151
Wangi Point Road	82



Date	14/07/2014
Day	Monday
Time	2:00pm - 3:30pm
Weather	Fine
Conducted by:	Daniel

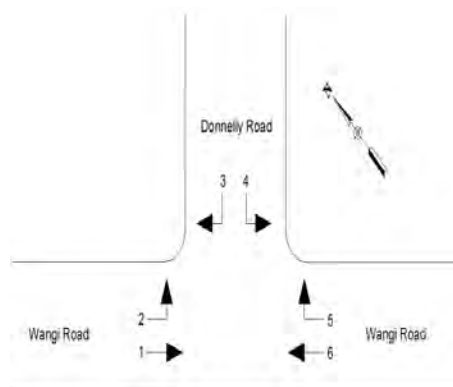


MOVEMENT	1	2	3	4	5	6
2:00 - 2:15	98	41	29	2	4	78
2:15 - 2:30	67	38	30	5	2	67
2:30 - 2:45	69	48	35	1	4	81
2:45 - 3:00	89	33	39	3	1	101
3:00 - 3:15	109	39	31	2	2	87
3:15 - 3:30	93	50	27	4	7	105

SUM	525	249	191	17	20	519
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PEAK	323	160	133	11	11	327
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Leg	PHT (vph)
Wangi Road West	943
Wangi Road East	672
Donnelly Road	315



Date 15/07/2014
Day Tuesday
Time 2:00pm - 3:30pm
Weather Fine/O'cast
Conducted by: Daniel



MOVEMENT	1	2	3	4	5	6
2:00 - 2:15	57	15	6	16	21	78
2:15 - 2:30	68	18	4	16	9	83
2:30 - 2:45	96	20	18	22	4	97
2:45 - 3:00	82	16	28	20	4	86
3:00 - 3:15	96	14	10	26	5	99
3:15 - 3:30	136	29	10	10	12	94

193

198

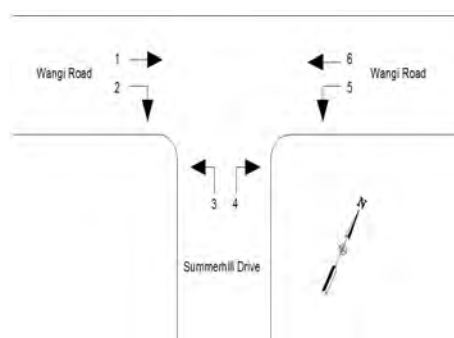
257

236

SUM	303	69	56	74	38	344
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PEAK	164	38	22	38	13	180
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Leg	PHT (vph)
Wangi Road West	404
Wangi Road East	395
Summerhill Drive	111



APPENDIX 2

SIDRA MOVEMENT SUMMARY SHEETS

MOVEMENT SUMMARY

Site: Donnelly Rd at Wangi Rd_2014 - Development

Donnelly Rd / Wangi Rd _ 2014
Giveway / Yield (Two-Way)

Movement Performance - Vehicles										
Mov ID	ODMo v	Demand Flows Total	Deg. Satn HV	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec	veh	m		per veh	km/h
South: Wangi Rd South										
2	T1	344	5.0	0.026	0.2	LOS A	0.1	1.1	0.03	59.7
3	R2	13	1.0	0.026	8.0	LOS A	0.1	1.1	0.50	53.7
Approach		357	4.9	0.086	0.4	NA	0.1	1.1	0.05	59.5
East: Donnelly Rd										
4	L2	155	1.0	0.211	8.2	LOS A	0.8	5.6	0.47	51.6
6	R2	13	1.0	0.211	8.2	LOS A	0.8	5.6	0.47	51.4
Approach		167	1.0	0.211	8.2	LOS A	0.8	5.6	0.47	51.6
North: Wangi Rd North										
7	L2	175	1.0	0.095	5.6	LOS A	0.0	0.0	0.00	53.6
8	T1	340	5.0	0.180	0.0	LOS A	0.0	0.0	0.00	60.0
Approach		515	3.6	0.180	1.9	NA	0.0	0.0	0.00	57.6
All Vehicles		1039	3.6	0.211	2.4	NA	0.8	5.6	0.09	57.2

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: Donnelly Rd at Wangi Rd_2014

Donnelly Rd / Wangi Rd _ 2014
Giveway / Yield (Two-Way)

Movement Performance - Vehicles										
Mov ID	ODMo v	Demand Flows Total	Deg. Satn HV	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec	veh	m		per veh	km/h
South: Wangi Rd South										
2	T1	344	5.0	0.026	0.2	LOS A	0.2	1.1	0.03	59.7
3	R2	12	1.0	0.026	8.0	LOS A	0.2	1.1	0.50	53.9
Approach		356	4.9	0.085	0.4	NA	0.2	1.1	0.05	59.5
East: Donnelly Rd										
4	L2	140	1.0	0.192	8.1	LOS A	0.7	5.0	0.46	51.6
6	R2	12	1.0	0.192	8.1	LOS A	0.7	5.0	0.46	51.4
Approach		152	1.0	0.192	8.1	LOS A	0.7	5.0	0.46	51.6
North: Wangi Rd North										
7	L2	168	1.0	0.091	5.6	LOS A	0.0	0.0	0.00	53.6
8	T1	340	5.0	0.180	0.0	LOS A	0.0	0.0	0.00	60.0
Approach		508	3.7	0.180	1.9	NA	0.0	0.0	0.00	57.7
All Vehicles		1016	3.7	0.192	2.3	NA	0.7	5.0	0.09	57.3

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: Summerhill Dr / Wangi Point Rd_2014

Wangi Point Rd
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows Total veh/h	Deg. Satn HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Summerhill Dr East											
5	T1	69	3.0	0.043	0.3	LOS A	0.2	1.6	0.19	0.07	58.5
6	R2	11	3.0	0.043	5.7	LOS A	0.2	1.6	0.19	0.07	56.2
Approach		80	3.0	0.043	1.0	NA	0.2	1.6	0.19	0.07	58.2
North: Wangi Point Rd											
7	L2	14	1.0	0.044	6.0	LOS A	0.1	1.0	0.18	0.57	53.1
9	R2	39	1.0	0.044	5.9	LOS A	0.1	1.0	0.18	0.57	52.6
Approach		53	1.0	0.044	5.9	LOS A	0.1	1.0	0.18	0.57	52.7
West: Summerhill Dr West											
10	L2	23	3.0	0.047	5.6	LOS A	0.0	0.0	0.00	0.16	56.9
11	T1	65	3.0	0.047	0.0	LOS A	0.0	0.0	0.00	0.16	58.6
Approach		88	3.0	0.047	1.5	NA	0.0	0.0	0.00	0.16	58.1
All Vehicles		221	2.5	0.047	2.4	NA	0.2	1.6	0.11	0.22	56.8

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: Summerhill Dr / Wangi Point Rd_2014 - Development

Wangi Point Rd
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows Total veh/h	Deg. Satn HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Summerhill Dr East											
5	T1	69	3.0	0.047	0.3	LOS A	0.2	1.8	0.21	0.12	58.1
6	R2	18	3.0	0.047	5.8	LOS A	0.2	1.8	0.21	0.12	55.8
Approach		87	3.0	0.047	1.4	NA	0.2	1.8	0.21	0.12	57.6
North: Wangi Point Rd											
7	L2	23	1.0	0.078	6.1	LOS A	0.3	1.9	0.20	0.58	53.0
9	R2	69	1.0	0.078	6.0	LOS A	0.3	1.9	0.20	0.58	52.6
Approach		93	1.0	0.078	6.0	LOS A	0.3	1.9	0.20	0.58	52.7
West: Summerhill Dr West											
10	L2	39	3.0	0.056	5.6	LOS A	0.0	0.0	0.00	0.22	56.3
11	T1	65	3.0	0.056	0.0	LOS A	0.0	0.0	0.00	0.22	58.0
Approach		104	3.0	0.056	2.1	NA	0.0	0.0	0.00	0.22	57.4
All Vehicles		284	2.3	0.078	3.2	NA	0.3	1.9	0.13	0.31	55.8

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: Summerhill Dr at Wangi Road

Summerhill Dr / Wangi Rd_2014
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand	Flows	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
		Total	HV	Vehicles			Distance				
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Summerhill Dr											
1	L2	23	0.0	0.092	8.1	LOS A	0.3	2.3	0.19	0.60	51.7
3	R2	40	0.0	0.092	8.1	LOS A	0.3	2.3	0.19	0.60	51.7
Approach		63	0.0	0.092	8.1	LOS A	0.3	2.3	0.19	0.60	51.7
East: Wangi Rd East											
4	L2	14	0.0	0.007	5.5	LOS A	0.0	0.0	0.00	0.58	53.6
5	T1	189	0.0	0.023	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		203	0.0	0.076	0.4	NA	0.0	0.0	0.00	0.04	59.5
West: Wangi Rd West											
11	T1	173	0.0	0.089	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
12	R2	40	0.0	0.034	6.3	LOS A	0.1	0.9	0.30	0.57	52.5
Approach		213	0.0	0.089	1.2	NA	0.1	0.9	0.06	0.11	58.4
All Vehicles		479	0.0	0.092	1.8	NA	0.3	2.3	0.05	0.14	57.9

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: Summerhill Dr at Wangi Road - Development

Summerhill Dr / Wangi Rd_2014
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed	
		Total veh/h	HV %			v/c	sec				Vehicles veh
South: Summerhill Dr											
1	L2	29	0.0	0.131	8.4	LOS A	0.5	3.4	0.21	0.61	51.4
3	R2	57	0.0	0.131	8.4	LOS A	0.5	3.4	0.21	0.61	51.5
Approach		86	0.0	0.131	8.4	LOS A	0.5	3.4	0.21	0.61	51.4
East: Wangi Rd East											
4	L2	21	0.0	0.012	5.5	LOS A	0.0	0.0	0.00	0.58	53.6
5	T1	189	0.0	0.023	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		211	0.0	0.076	0.6	NA	0.0	0.0	0.00	0.06	59.3
West: Wangi Rd West											
11	T1	173	0.0	0.089	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
12	R2	56	0.0	0.047	6.3	LOS A	0.2	1.3	0.31	0.58	52.5
Approach		228	0.0	0.089	1.5	NA	0.2	1.3	0.08	0.14	58.0
All Vehicles		525	0.0	0.131	2.3	NA	0.5	3.4	0.07	0.18	57.3

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Appendix C – Air Quality Impact Assessment (SLR 2014)



global environmental solutions

Myuna Colliery Modification Air Quality Impact Assessment

Report Number 630.10123.05000-R1

29 October 2014

Centennial Myuna Pty Ltd
Myuna Colliery
14 Summerhill Drive
Wangi Wangi NSW 2267

Version: Revision 0

Myuna Colliery Modification

Air Quality Impact Assessment

PREPARED BY:

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
2 Lincoln Street Lane Cove NSW 2066 Australia

(PO Box 176 Lane Cove NSW 1595 Australia)
T: 61 2 9428 8100 F: 61 2 9427 8200
E: sydney@slrconsulting.com www.slrconsulting.com

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the Client. Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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DOCUMENT CONTROL

Reference	Status	Date	Prepared	Checked	Authorised
630.10123.05000-R1	Revision 0	29 October 2014	Martin Doyle Varun Marwaha	Gary Graham	Martin Doyle

Executive Summary

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by Centennial Myuna Pty Ltd (CMPL) to conduct an Air Quality Impact Assessment (AQIA) for the Myuna Colliery Modification Project (the Project) located within the Northern Coalfield of NSW approximately 90 kilometres (km) northeast of Sydney. Myuna Colliery's Surface Facilities Area is located in Wangi Wangi on the western side of Lake Macquarie, 25 km southwest of Newcastle.

CMPL currently operate under Project Approval (PA) 10_0080 which was granted in January 2012 and allows extraction of up to 2 million tonnes of ROM coal from the site per calendar year. CMPL wishes to modify this PA to allow extraction of up to 3 million tonnes of ROM coal per calendar year.

The assessment of the potential impacts on air quality resulting from Project operation has included an assessment of impacts during both currently approved and proposed mining activities, with emissions of particulate matter (or dust) and odour resulting from each scenario calculated to reflect the possible worst case operation of the Project (i.e. the operation of the emergency coal stockpile).

A dispersion modelling assessment has been performed in which the calculated and controlled emissions were used as input, as was meteorological data which has been shown to represent the area appropriately. In addition, an estimate of the existing air quality (i.e. that without the impact of the Project) was made using data collected in the immediate area and an inclusion of the potential impacts of power station operation has also been included.

An assessment of the impacts of the Northern Coal Logistics Project has also been performed to ensure that the operation of the Project is not limited by operations of this nearby operation.

The findings of the dispersion modelling assessment indicate that (under both the currently approved and proposed Project operation):

- All annual average particulate impacts (dust deposition, PM₁₀, PM_{2.5}, TSP) are in compliance with advisory reporting standards, NSW EPA and WHO criteria at all receptors assessed;
- All annual average criteria remain in compliance with advisory reporting standards, NSW EPA and WHO criteria when taking into account the Northern Coal Logistics Project;
- Maximum 24-hour PM_{2.5} concentrations are predicted to be below the advisory reporting standard at all receptors assessed, including an approximation of background (i.e. existing air quality); and
- Maximum 24-hour PM₁₀ concentrations are predicted to be below the NSW EPA criterion of 50 µg/m³ (and the potential criterion of 40 µg/m³) at all receptors including an approximation of background (i.e. existing air quality).
- Odour concentrations are predicted to be below the NSW EPA criterion of 2 OU at all receptors assessed.

Through this dispersion modelling exercise, it has been shown that the operation of the Project under both the 2 Mtpa and 3 Mtpa production rates will not cause any exceedances of the adopted criteria at any receptor assessed. Additionally, changes in the air quality resulting from the proposed production increase are predicted to be minimal with impacts dominated by operations at the emergency coal stockpiles, at which operations are not proposed to change.

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APPENDICES

Appendix A	Contour Plots
Appendix B	Description of Results Tables for 24-hour Particulate Impacts

ABBREVIATIONS

%	percent
°C	degrees Celsius
µg	microgram
µg/m ³	microgram per cubic metre of air
µg/Nm ³	microgram per normalised cubic metre of air (273K, 101.3kPa)
µm	micrometre or micron
AGL	above ground level
AHD	Australian Height Datum
AP-42	US EPA Emission Factor Handbook
AQIA	air quality impact assessment
AWS	automatic weather station
BMP	best management practice
CMPL	Centennial Myuna Pty Ltd
CSIRO	Australian Commonwealth Scientific and Industrial Research Organisation
DECC	NSW Department of Environment and Climate Change (see OEH)
DECCW	NSW Department of Environment, Climate Change and Water (see OEH)
DDG	dust deposition gauge
DP&I	Department of Planning and Infrastructure
DGRs	Director General's Requirements
EETM	Emission Estimation Technique Manual
EF	Emission Factor
EIS	Environmental Impact Statement
EPA	Environment Protection Authority
EPS	Eraring Power Station
FEL	front-end loader
g	gram
g/m ² /month	grams per square metre per month
GMR	Greater Metropolitan Region
HVAS	High Volume Air Sampler
ha	hectare
J	joule
K	degrees Kelvin
kg	kilogram
kg/hr	kilogram per hour
km	kilometre
km E	kilometres east
km N	kilometres north
kPa	kiloPascal
kV	kilovolt
L	litre
m	metre
M	million
m/s	metre per second
m ²	square metre
m ³	cubic metre
min	minute
mm	millimetre
Mt	million tonnes
Mtpa	million tonnes per annum
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NPI	National Pollutant Inventory (Australia)
NSW	New South Wales
OEH	NSW Office of Environment and Heritage

PM	Particulate Matter
PM ₁₀	particular matter with an equivalent aerodynamic diameter of 10 microns or less
PM _{2.5}	particular matter with an equivalent aerodynamic diameter of 2.5 microns or less
ppb	parts per billion (10 ⁹)
ppm	parts per million (10 ⁶)
ROM	run of mine
SI	Système International
t	tonne
tpa	tonnes per annum
TEOM	tapered element oscillating microbalance
tpa	tonnes per annum
TSP	total suspended particulate matter
US EPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
WGS	World Geodetic System
WHO	World Health Organisation

GLOSSARY

air dispersion model	A computer-based software program which provides a mathematical prediction of how pollutants from a source will be distributed in the surrounding area under specific conditions of wind, temperature, humidity and other environmental factors
airshed	The geographical area associated with a given air supply
algorithms	A step-by-step problem-solving procedure, especially an established, recursive computational procedure for solving a problem in a finite number of steps
ambient	Pertaining to the surrounding environment or prevailing conditions
anemometer	An instrument for measuring wind force and velocity
atmosphere	A gaseous mass surrounding the planet Earth that is retained by Earth's gravity. It is divided into five layers. Most of the weather and clouds are found in the first layer
atmospheric stability	The tendency of the atmosphere to resist or enhance vertical motion
atmospheric pressure	The force per unit area exerted against a surface by the weight of air above that surface in the Earth's atmosphere
background	The existing air quality in the Project area excluding the impacts from the proposed development
baseline monitoring program	A monitoring program designed to measure the ambient concentration levels which currently exist prior to the proposed development
CALMET	A meteorological model that develops wind and temperature fields on a three-dimensional gridded modelling domain
CALPOST	A post-processor used to process CALPUFF files, producing tabulations that summarize results of the simulation for user-selected averaging periods
CALPUFF	A transport and dispersion model that advects "puffs" of material emitted from modelled sources, simulating dispersion and transformation processes
climatological	The science dealing with climate and climatic phenomena
combustion	The process of thermal oxidation. A chemical change, especially oxidation, accompanied by the production of heat and light
commissioning	A systematic process of ensuring that a new facility performs according to the documented design intent and the owner's operational needs, and that specified system documentation and training are provided to the facility staff
crushers	A machine designed to reduce large rocks into smaller rocks, gravel, or rock dust
decommissioning	Planned shut-down or removal of a building, equipment, plant, etc., from operation or usage
dust deposition	Settling of particulate matter out of the air through gravitational effects (dry deposition) and scavenging by rain and snow (wet deposition)
dispersion	The spreading and dilution of substances emitted in a medium (e.g. air or water) through turbulence and mixing effects
diurnal	Relating to or occurring in a 24-hour period; daily
downwash	The grounding of an air pollution plume as it flows over nearby buildings or other structures due to turbulent eddies being formed in the downwind side of the building, resulting in elevated ground level concentrations.
downwind	The direction in which the wind is blowing

emission factor	A measure of the amount of a specific pollutant or material emitted by a specific process, fuel, equipment, or source based on activity data such as the quantity of fuel burnt, hours of operation or quantity of raw material consumed.
emissions inventory	A database that lists, by source, the amount of air pollutants discharged into the atmosphere from a facility over a set period of time (e.g. per annum, per hour)
erodible	A term used to describe a soil that is vulnerable to erosion by the agents of wind, water, ice
evapotranspiration	The process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces
epidemiological	The branch of medicine that deals with the study of the causes, distribution, and control of disease in populations
fossil fuel	A natural fuel such as coal, diesel or gas, formed in the geological past from the remains of living organisms
fugitive emissions	Pollutants which escape from an industrial process due to leakage, materials handling, transfer, or storage
guideline	A general rule, principle, or piece of advice. A statement or other indication of policy or procedure by which to determine a course of action.
meteorological	The science that deals with the phenomena of the atmosphere, especially weather and weather conditions
mixing height	The height to which the lower atmosphere will undergo mechanical or turbulent mixing, producing a nearly homogeneous air mass
modelling domain	The area over which the model is making predictions
particulate	Of, relating to, or formed of minute separate particles. A minute separate particle, as of a granular substance or powder
plume	A space in air, water, or soil containing pollutants released from a point source
point source	A pollution source that is fixed and/or uniquely identifiable, such as a stack, chimney, outlet pipe or vent
pollutant	A substance or energy introduced into the environment that has undesired effects, or adversely affects the usefulness of a resource
prognostic	A prediction of the value of variables for some time in the future on the basis of the values at the current or previous times
qualitative assessment	An assessment of impacts based on a subjective, non-statistical oriented analysis
quantitative assessment	An assessment of impacts based on estimates of emission rates and air dispersion modelling techniques to provide estimate values of ground level pollutant concentrations.
receptor	Coordinate locations specified in an air dispersion model where ground level pollutant concentrations are calculated by the model
sensitive receptor	Locations such as residential dwellings, hospitals, churches, schools, recreation areas etc where people (particularly the young and elderly) may often be present, or locations with sensitive vegetation and crops.
spatial variation	Pertaining to variations across an area
standard	The prescribed level of a pollutant in the outside air that should not be exceeded during a specific time period to protect public health
standard deviation of wind direction	A measure of the variation in wind direction

synoptic meteorological data	A surface weather observation, made at periodic times (usually at 3-hourly and 6-hourly intervals), of sky cover, state of the sky, cloud height, atmospheric pressure reduced to sea level, temperature, dew point, wind speed and direction, amount of precipitation, hydrometeors and lithometeors, and special phenomena that prevail at the time of the observation or have been observed since the previous specified observation
temporal variation	Pertaining to variations with time
topography	Detailed mapping or charting of the features of a relatively small area, district, or locality
wind direction	The direction from which the wind is blowing
wind erosion	Detachment and transportation of loose topsoil or sand due to action by the wind
wind rose	A meteorological diagram depicting the distribution of wind direction and speed at a location over a period of time

1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by Centennial Myuna Pty Ltd (CMPL) to conduct an Air Quality Impact Assessment (AQIA) for the Myuna Colliery Modification Project (the Project) located within the Northern Coalfield of NSW approximately 90 kilometres (km) northeast of Sydney. Myuna Colliery's Surface Facilities Area is located in Wangi Wangi on the western side of Lake Macquarie, 25 km southwest of Newcastle.

Continuous miner bord and pillar operations have occurred at Myuna Colliery in the Wallarah, Great Northern and Fassifern seams since 1981. Centennial Myuna was granted approval in January 2012 under Project Approval (PA) 10_0080 to extract up to 2 million tonnes per annum (Mtpa) of run of mine (ROM) coal until 31 December 2032 within Consolidated Coal Lease 762 (CCL762) and Mining Lease 1370.

CMPL wishes to modify this PA to allow:

- an increase in coal extraction to not more than 3 million tonnes; and
- increase employment to 300 full time employees.

The aim of this AQIA is to assess the potential air quality impacts on surrounding sensitive receivers associated with the Project.

The New South Wales Environment Protection Authority (NSW EPA) "*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*" (DEC, 2005) (the Approved Methods) outline the requirements for conducting an AQIA (and the Sections of this report where the requirements are met), as follows:

- Description of local topographic features and sensitive receptor locations (**Section 3.1** and **Section 3.2** respectively);
- Establishment of air quality assessment criteria (**Section 4**);
- Analysis of climate and dispersion meteorology for the region (**Section 6.2**);
- Description of existing air quality environment (**Section 7**);
- Compilation of a comprehensive emissions inventory for the existing and proposed activities (**Section 5**);
- Completion of atmospheric dispersion modelling and analysis of results (**Section 8**); and
- Preparation of an air quality impact assessment report comprising the above.

The scope for this AQIA has been designed to address the requirements of the NSW Department of Planning and Infrastructure (DP&I) who have requested

"...a revised Air Quality Impact Assessment that models the effects of the increase in coal movements on the site and any relevant changes to surface activities or changes to mine ventilation volumes' (8 August 2014)."

The assessment has been performed in accordance with relevant policies, guidelines and plans including:

- Protection of Environment Operations (Clean Air) Regulation 2002;
- Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (2005); and,
- Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (2006).

2 PROJECT OVERVIEW

2.1 Background

Myuna Colliery is an underground coal mine owned and operated by Centennial Myuna Pty Limited (CMPL), a wholly owned subsidiary of Centennial Coal Company Limited (Centennial). Myuna Colliery is located 25 km south-west of Newcastle, New South Wales (NSW) in the Lake Macquarie and Wyong Local Government Areas (LGA).

Continuous miner bord and pillar operations have occurred at Myuna Colliery in the Wallarah, Great Northern and Fassifern seams since 1981. Centennial Myuna was granted approval in January 2012 under PA 10_0080 to extract up to 2 Mtpa of ROM coal until 31 December 2032 within Consolidated Coal Lease 762 (CCL762) and Mining Lease 1370.

The consolidated Project Approval area is shown on **Figure 1**.

2.2 Project Description

CMPL has current approval to extract up to 2 Mtpa of ROM coal. CMPL are seeking to modify Project Approval 10_0080 pursuant to Section 75W of Part 3A of the EP&A Act to allow:

- an increase in coal extraction to not more than 3 million tonnes; and
- increase employment to 300 full time employees.

Table 1 details the current approved operations at the Myuna Colliery and the proposed changes to those operations as a result of the Project.

Table 1 Comparison of Approved and Proposed Operations at Myuna Colliery

Aspect	Approved Operations	Proposed Modifications
Life of Mine	31st December 2032	No change
Operational Hours	24 hours a day, seven days per week.	No change
Operational Employment	Up to 210 full-time personnel.	Increase in full time personnel to 300. An additional 90.
Mine Access	Myuna Colliery Surface Site men and materials drift.	No change
Mine Plan and Mining Method	Zone A first workings only. Zone B second workings are limited to partial pillar extraction within Great Northern and Fassifern seams.	No change No change
Surface Infrastructure	Myuna Colliery Surface Site.	No change
Servicing	Existing connections to Hunter Water Corporation's reticulated potable water system, Ausgrid's reticulated electricity network, and Telstra's telecommunications networks.	No change
Coal Extraction	The proponent shall not extract more than 2 million tonnes of ROM coal from the site in any calendar year.	Increase in ROM coal extraction from 2Mtpa to 3Mtpa.
Coal Transport	All coal is transported from the site via the enclosed overland coal conveyor to Eraring Power Station	No change
Water Management	In accordance with the Myuna Colliery Water Management Plan.	No change
General Waste Management	Management systems in place for the various non-production waste streams, including general waste, maintenance consumables, waste oils and grease and sewage.	No change
Post Mining Closure and Rehabilitation	In accordance with the Myuna Colliery Mine Operations Plan.	No change
Environmental Management	Myuna Colliery EMS provides a framework under which environmental matters are managed at the Myuna Colliery.	No change
Subsidence Management	As per Schedule 3 of Project Approval 10_0080, Condition : The proponent shall ensure that vertical subsidence within zone A is limited to a maximum of 20mm and that extraction methods are limited to first workings only. The proponent shall ensure that vertical subsidence within Zone B is limited to 650mm and second workings are limited to partial pillar extraction within Great Northern and Fassifern seams The proponent shall seek approval from the DSC prior to mining within the Eraring Dam Notification Area.	No change

Figure 1 Myuna Colliery Consolidated Approval Area



2.3 Identification of Emission Sources

During the operation of the Project, the equipment and operations identified in **Table 2** will be used and performed.

Table 2 Processes and Equipment used during Myuna Colliery Operations

Process / Operation	Equipment	Number
Transfer of coal from underground workings to surface ROM bin	Conveyor	1
Transfer of coal from ROM bin to breaker	Conveyor	1
Coal breaking	Breaker	1
Transfer of coal from breaker to screen	Conveyor	1
Coal screening	Screen	1
Transfer of coal from screen to crusher	Conveyor	1
Coal crushing	Crusher	1
Transfer of coal from crusher to finished product bin	Conveyor	1
Transfer of finished product to Eraring Power Station	Conveyor	1
Loading of coal from ROM bin to trucks	Road trucks	-
Hauling of coal from ROM bin to Emergency Stockpile (and return)	Road trucks	-
Unloading/loading of coal at Emergency Stockpile	Road trucks	-
Movement of coal at Emergency Stockpile	Front end loader	1
Truck unloading to reclaim bin	Road trucks	-
Upcast ventilation	Upcast ventilation fans	1
Wind erosion of Emergency Stockpile and two water storage dams (when not at capacity)	-	-

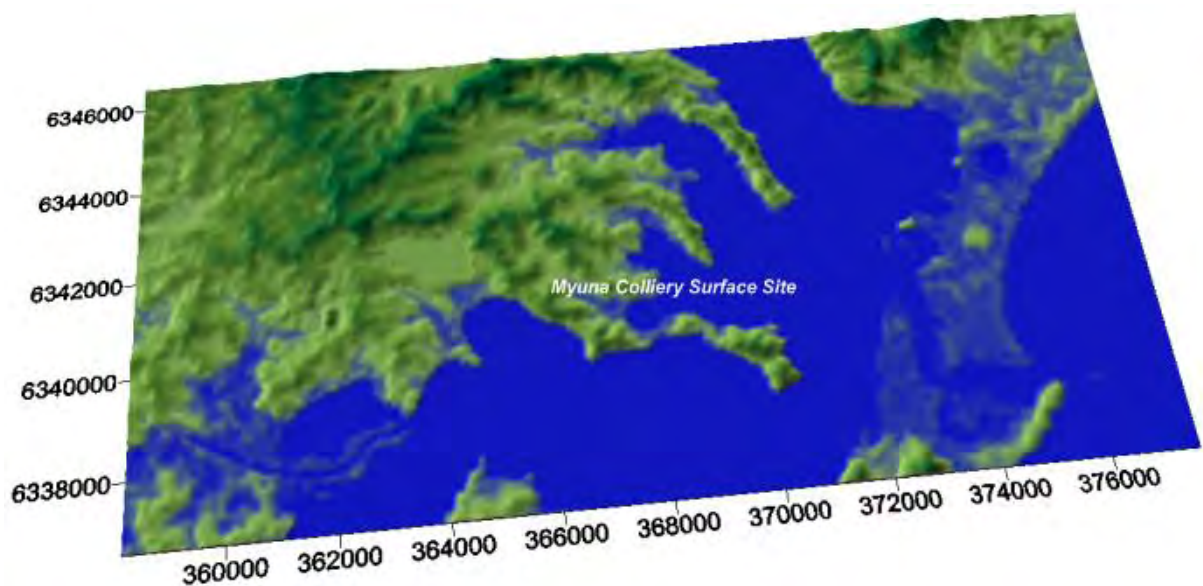
3 STUDY AREA

3.1 Local Topography

The topographical data used in the meteorological and dispersion modelling was sourced from the United States Geological Service's Shuttle Radar Topography Mission database that has recorded topography across Australia with a 3 arc second (~90 m) spacing.

The topography of the local region surrounding the Project Application Area and surrounds is presented in **Figure 2**.

Figure 2 Local and Regional Topography



3.2 Sensitive Receptors

A number of residences are located immediately adjacent to the boundary of the Surface Facilities Area. The nearest residences have been identified as sensitive receptor locations to be taken into account during the assessment.

The nearest sensitive receiver is located approximately 0.5 km south east of the infrastructure at Myuna Colliery's Surface Facilities Area. A list of the nearest sensitive receptors (nominated as 'R1' to 'R8') identified in the immediate vicinity of the Surface Facilities Area, and their respective distances from the Surface Facilities Area boundary, are presented in **Table 3** and **Figure 3**.

Table 3 Nearest Sensitive Receptors

Receptor ID	Location	Receptor Location		Distance (km) and Direction from Mine Infrastructure
		Easting (m, UTM)	Northing (m, UTM)	
R1	2 Turruma Street, Wangi Wangi	366,858	6,340,370	0.5 SW
R2	2 Moani Street, Wangi Wangi	366,652	6,340,175	0.5 SE
R3	3 Sunset Close, Wangi Wangi	365,707	6,340,844	0.5 W
R4	119 Donnelly Road, Arcadia Vale	366,662	6,341,662	0.9 N
R5	93 Donnelly Road, Arcadia Vale	366,857	6,341,348	0.7 NNE
R6	83 Donnelly Road, Arcadia Vale	367,049	6,341,185	0.7 NE
R7	63 Donnelly Road, Arcadia Vale	367,091	6,340,965	0.6 NE
R8	53 Donnelly Road, Arcadia Vale	367,072	6,340,821	0.5 NE

Figure 3 Surrounding Sensitive Receptor Locations



4 AMBIENT AIR QUALITY CRITERIA

State air quality guidelines adopted by the NSW EPA are published in the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (2005).

The Approved Methods has been consulted during the preparation of this assessment report. The Approved Methods lists the statutory methods that are to be used to model and assess emissions of air pollutants from stationary sources in NSW. Section 7.1 of the Approved Methods clearly outlines the impact assessment criteria for the Project. The criteria listed in the Approved Methods are derived from a range of sources (including NHMRC, NEPC, WHO and ANZEEC). The criteria specified in the Approved Methods are the defining ambient air quality criteria for NSW, and are considered to be appropriate for the setting.

4.1 Particulate Matter

Airborne contaminants that can be inhaled directly into the lungs can be classified on the basis of their physical properties as gases, vapours or particulate matter. In common usage, the terms “dust” and “particulates” are often used interchangeably. The term “particulate matter” refers to a category of airborne particles, typically less than 30 microns (μm) in diameter and ranging down to 0.1 μm and is termed total suspended particulate (TSP). The annual goal for TSP recommended by the NSW EPA is 90 micrograms per cubic metre of air ($\mu\text{g}/\text{m}^3$).

The TSP goal was developed before the more recent results of epidemiological studies which suggested a relationship between health impacts and exposure to concentrations of finer particulate matter.

Emissions of particulate matter less than 10 μm and 2.5 μm in diameter (referred to as PM_{10} and $\text{PM}_{2.5}$ respectively) are considered important pollutants due to their ability to penetrate into the respiratory system. In the case of the $\text{PM}_{2.5}$ category, recent health research has shown that this penetration can occur deep into the lungs. Potential adverse health impacts associated with exposure to PM_{10} and $\text{PM}_{2.5}$ include increased mortality from cardiovascular and respiratory diseases, chronic obstructive pulmonary disease and heart disease, and reduced lung capacity in asthmatic children.

The NSW EPA PM_{10} assessment goals set out in the Approved Methods are as follows:

- a 24-hour maximum of 50 $\mu\text{g}/\text{m}^3$; and
- an annual average of 30 $\mu\text{g}/\text{m}^3$.

The World Health Organisation (WHO) also set goals for PM_{10} which are as follows:

- a 24-hour maximum of 50 $\mu\text{g}/\text{m}^3$; and
- an annual average of 20 $\mu\text{g}/\text{m}^3$.

It is noted that the annual average goal for PM_{10} set by the WHO is more stringent than that set by the NSW EPA. Both goals are assessed within this report even considering that the 30 $\mu\text{g}/\text{m}^3$ annual average PM_{10} goal is appropriate for the setting.

The Approved Methods currently do not set any assessment goals for $\text{PM}_{2.5}$. In December 2000, the National Environment Protection Council (NEPC) initiated a review to determine whether a national ambient air quality criterion for $\text{PM}_{2.5}$ was required in Australia, and the feasibility of developing such a criterion. The review found that:

- there are health effects associated with these fine particles;
- the health effects observed overseas are supported by Australian studies; and
- fine particle standards have been set in Canada and the USA, and an interim criterion is proposed for New Zealand.

The review concluded that there is sufficient community concern regarding PM_{2.5} to consider it an entity separate from PM₁₀.

As such, in July 2003, a variation to the Ambient Air Quality NEPM was made to extend its coverage to PM_{2.5}, setting the following Interim Advisory Reporting Standards for PM_{2.5}:

- a 24-hour average concentration of 25 µg/m³; and
- an annual average concentration of 8 µg/m³.

The World Health Organisation also set goals for PM_{2.5} which are as follows:

- a 24-hour maximum of 25 µg/m³; and
- an annual average of 10 µg/m³.

The WHO goals for PM_{2.5} are either the same (24 hour maximum) or less stringent (annual average) than those advised within the NEPM.

It is noted that the NEPM Advisory Reporting Standards relating to PM_{2.5} particles are reporting guidelines only at the present time and not intended to represent air quality criteria. A summary of the particulate guidelines is shown in **Table 4**.

Table 4 EPA Goals for Particulates

Pollutant	Averaging Time	Goal
TSP	Annual	90 µg/m ³
PM ₁₀	24 Hours	50 µg/m ³
	Annual	30 µg/m ³
PM _{2.5}	24 Hours	25 µg/m ³ (interim advisory reporting standard only)
	Annual	8 µg/m ³ (interim advisory reporting standard only)

Reference should be made to **Section 4.4** regarding to the current status of assessment criteria for particulates in NSW.

4.2 Nuisance Impacts

4.2.1 Fugitive Emissions of Dust

The preceding section is concerned in large part with the health impacts of airborne particulate matter. Nuisance impacts need also to be considered, mainly in relation to deposited dust. In NSW, accepted practice regarding the nuisance impact of dust is that dust-related nuisance can be expected to impact on residential areas when annual average dust deposition levels exceed 4 grams per square metre per month (g/m²/month).

Table 5 presents the impact assessment goals set out in the Approved Methods for dust deposition, showing the allowable increase in dust deposition level over the ambient (background) level to avoid dust nuisance.

Table 5 EPA Goals for Allowable Dust Deposition

Averaging Period	Maximum Increase in Deposited Dust Level	Maximum Total Deposited Dust Level
Annual	2 g/m ² /month	4 g/m ² /month

Source: Approved Methods, NSW DEC 2005.

4.2.2 Odour Emissions

According to NSW EPA, impact assessment criteria for complex mixtures of odours have been designed to take into account the range of sensitivity to odours within the community and to provide additional protection for individuals with a heightened response to odours. Where a number of the factors simultaneously contribute to making an odour “offensive”, an odour goal of 2 OU at the nearest residence (existing or any likely future residences) is appropriate, which generally occurs for affected populations equal or above 2,000 people.

The equation used by the NSW EPA to determine the appropriate impact assessment criteria for complex mixtures of odorous air pollutants, as specified in the Approved Methods, is expressed as follows:

$$\text{Impact assessment criterion (OU)} = (\log_{10}(\text{population}) - 4.5) / -0.6$$

A summary of appropriate impact assessment criteria for various population densities is provided **Table 6**.

Table 6 Impact assessment criteria for complex mixtures of odorous air pollutants

Population of affected community	Impact assessment criteria for complex mixtures of odorous air pollutants (Odour Units, OU)
Urban ($\geq \sim 2000$) and/or schools and hospitals	2.0
~ 500	3.0
~ 125	4.0
~ 30	5.0
~ 10	6.0
Single rural residence ($\leq \sim 2$)	7.0

The impact assessment criterion to be used for this assessment is calculated using the procedures described in the Approved Methods. Based on the number of identified sensitive receptors to the southeast and east of the Project Site, it is considered that an odour criterion of 2 OU would be applicable for the Project.

4.3 Summary of Project Air Quality Goals

The air quality goals adopted for this assessment, which confirm to current EPA and Federal air quality criteria, are summarised in **Table 7**.

Table 7 Project Air Quality Goals

Pollutant	Averaging Time	Goal
TSP	Annual	90 µg/m ³ (NSW EPA)
PM ₁₀	24 Hours	50 µg/m ³ (NSW EPA)
	Annual	30 µg/m ³ (NSW EPA)
	Annual	20 µg/m ³ (WHO)
PM _{2.5}	24 Hours	25 µg/m ³ (NEPM interim <u>advisory</u> reporting standard only)
	Annual	8 µg/m ³ (NEPM interim <u>advisory</u> reporting standard only)
Dust Deposition	Annual	Maximum Incremental (Project only) increase of 2 g/m ² /month Maximum Total of 4 g/m ² /month (Project and other sources)
Odour	1-hour	2 OU (99 th percentile)

Source: Approved Methods, NSW DEC 2005, WHO 2005.

4.4 Potential Changes to the Ambient Air Quality NEPM

On 29 April 2014, Environment Ministers signalled their intent to vary the Ambient Air Quality NEPM based on the latest scientific understanding of the health risks resulting from airborne particulate pollution. The variation to the Ambient Air Quality NEPM is the subject of consultation with the wider affected community until 10 October 2014 although the standards presented in **Table 8** have been proposed as a potential 'preferred option'.

Table 8 Proposed Variation to the Ambient Air Quality NEPM

Metric	Averaging Period	Current Standard	Options for Standard	Allowed Exceedances
PM ₁₀	Annual average	None	No standards with consideration of 20 µg/m ³	N/A
	24-hour mean	50 µg/m ³	50 µg/m ³ , with consideration of 45 µg/m ³ and 40 µg/m ³	See note below
PM _{2.5}	Annual average	8 µg/m ³ (advisory)	8 µg/m ³	N/A
	24-hour mean	25 µg/m ³ (advisory)	25 µg/m ³	See note below

The four options for the form of the 24-hour standards, and specifically the treatment of exceedances, for both PM₁₀ and PM_{2.5} are as follows:

- Business as usual option; a rule that allows a fixed number of exceedances of a PM standard in a given year, with no exclusion of data for exceptional events.
- A rule that allows a fixed number of exceedances of a PM standard in a given year, but with exclusion of data for exceptional events.
- A rule in which the 98th percentile PM concentration in a given year is compared with a standard, with no exclusion of data for exceptional events.
- A rule in which the 98th percentile PM concentration in a given year is compared with a standard, but with exclusion of data for exceptional events.

It has been identified by the NEPC that it is likely that jurisdictions will want to identify local issues that affect the form of the standards and therefore the options for this standard have been left open for the consultation phase.

For the purposes of this assessment, discussion is provided on the basis of an adopted annual average PM_{10} concentration of $20 \mu\text{g}/\text{m}^3$ (numerically identical to the WHO PM_{10} annual average standard), and adoption of the current advisory $\text{PM}_{2.5}$ standards (24-hour and annual average).

Limited discussion is provided on the potential for exceedance of the proposed 24-hour PM_{10} standard of $40 \mu\text{g}/\text{m}^3$ (in addition to the current standard of $50 \mu\text{g}/\text{m}^3$).

5 EMISSIONS ESTIMATION

This section describes the operational scenarios assessed (**Section 5.1**), the assumptions used in the calculation of emissions (**Section 5.2**) and the methodology used to estimate emissions (**Section 5.3**).

5.1 Scenarios Assessed

Two scenarios have been quantified to assess the pollutant emissions due to currently approved operations (at 2 Mtpa) and proposed operations (at 3 Mtpa). A scenario to assess the impacts of operations at 2 Mtpa extraction rate was presented in “Myuna Colliery Extension of Mining Project, Air Quality Impact Assessment” (SLR (previously Heggies), October 2010). Since the publication of this assessment, a number of emission factors have been updated, and further work has been performed at the site with regard to emission control which warrants a re-assessment of these impacts.

A summary of the emission sources assessed in both scenarios is shown in **Table 9**. Emission sources for both the current and proposed operation of the Myuna Colliery will remain constant, although the intensity at which each source operates may change.

Table 9 Summary of the Scenarios Assessed

Emission Source	Pollutants
Transfer of coal from underground workings to surface ROM bin	TSP, PM ₁₀ , PM _{2.5} and deposited dust
Transfer of coal from ROM bin to breaker	
Coal breaking	
Transfer of coal from breaker to screen	
Coal screening	
Transfer of coal from screen to crusher	
Coal crushing	
Transfer of coal from crusher to finished product bin	
Transfer of finished product to Eraring Power Station	
Loading of coal from ROM bin to trucks	
Hauling of coal from ROM bin to Emergency Stockpile (and return)	
Unloading/loading of coal at Emergency Stockpile	
Movement of coal at Emergency Stockpile	
Wind erosion of Emergency Stockpile and two water storage dams (when not at capacity)	
Truck unloading to reclaim bin	
Upcast ventilation	TSP, PM ₁₀ , PM _{2.5} , deposited dust and odour

5.2 Assumptions used in Emission Calculations

The assumptions used in the construction of the emissions inventory for the scenario are presented in **Table 10**. These assumptions have been provided by Centennial, or are taken from the ‘Dust Stop’ Pollution Reduction Program Assessment performed by SLR (2012).

Table 10 Assumptions used in Air Quality Impact Assessment

Parameter	Value	Units	Reference
General – Current and Proposed Operations			
Operating hours	168	hours/week	-
Operating days	365	days/year	-
Coal – Current Operations			
Total coal production	2,000,000	tonnes/year	
Maximum daily coal production	10,500	tonnes/day	
Total reject	2,000	tonnes/year	Assumed 0.1% of production (SLR, 2012c)
Maximum daily reject	105	tonnes/day	
Total product	1,998,000	tonnes/year	Assumed 99.9% of production (SLR, 2012c)
Maximum daily product	10,395	tonnes/day	
Silt content	6	%	Centennial (2014)
Moisture content	8	%	SLR, 2012c
Coal – Proposed Operations			
Total coal production	3,000,000	tonnes/year	
Maximum daily coal production	15,000	tonnes/day	
Total reject	3,000	tonnes/year	Assumed 0.1% of production (SLR, 2012c)
Maximum daily reject	150	tonnes/day	
Total product	2,997,000	tonnes/year	Assumed 99.9% of production (SLR, 2012c)
Maximum daily product	14,850	tonnes/day	
Silt content	6	%	Centennial (2014)
Moisture content	8	%	SLR, 2012c
Haulage - Current and Proposed Operations			
Length of road to Emergency Coal Stockpile	300	metres	Calculated from Google Earth (2014)
Quantity of coal to Emergency Coal Stockpile	7,000	tonnes/year	Assumed maximum
Number of truck trips from ROM bin to Emergency Coal Stockpile	140	trips/year	Assumed payload of road trucks of 50 t
Mean truck weight	75	tonnes	SLR, 2012c
Silt content of roads	25	%	SLR, 2012c
Wind Erosion- Current and Proposed Operations			
Area of combined Dam 1-3	0.048	ha	Assumed 20% of total area (SLR, 2012c)
Area of Dam 4 at Emergency Coal Stockpile	0.012	ha	Assumed 20% of total area (SLR, 2012c)
Area of Emergency Coal Stockpile	0.48	ha	Assumed to be active for only 4 days per year
Ventilation Fans - Current and Proposed Operations			
Ventilation fan diameter	4.82	metres	Calculated from Google Earth (2014)
Volumetric flow rate (per fan)	153	m ³ /s	Centennial (2014)

5.2.1 Particulate Emission Controls

CMPL operate an Air Quality and Greenhouse Gas Management Plan (August, 2012) with the measures identified below being implemented at Myuna Colliery as part of that plan. Where relevant, emission control factors for each dust suppression activity are outlined and have been applied to the estimation of emissions resulting from the operation of the (1) currently approved and (2) proposed Project. Control factors are sourced from Australian Government Department of Sustainability, Environment, Water, Population and Communities 2012, "*National Pollutant Inventory Emission Estimation Technique for Mining*", Version 3.1, (DSEWPC, 2012).

Behaviour and Operation Modification

When conditions are identified as being likely to cause dust impacts, Myuna Colliery implements proactive dust control measures (e.g. increased watering rates) to prevent dust events from occurring. In the event that excessive dust is noted on site, the following steps are required to be taken:

- Identify the major sources of dust; and,
- Assign water cart to high priority areas.

As no particular wind conditions or measured dust levels are identified as triggers for modification of activities, particulate control efficiencies cannot be calculated.

Rehabilitation

All surface infrastructure associated with Myuna Colliery's operations is located at the Surface Facilities Area. The Surface Facilities Area encompasses a footprint of approximately 89 ha, of which 21 ha includes the surface infrastructure. This 21 ha is the total area currently requiring rehabilitation prior to mine closure. The remainder of the Surface Facilities Area is predominantly natural bushland vegetation, the Wangi Creek watercourse and existing cleared easement corridors (AEMR, 2012 p33).

In the AEMR reporting period (2012), no rehabilitation works were performed.

Sealing and Sweeping of Haul Roads

The distance travelled by trucks at Myuna Colliery is very low, and these movements are generally limited to periods when the Eraring Power Station is unable accept coal, requiring excess ROM coal from the underground operations to be transferred from the ROM Bin into trucks for placement at the Emergency Stockpile Area.

The haul roads between the ROM Bin and the Emergency Stockpile area and between the ROM Bin and the Waste Bin are sealed and are swept/watered as required when in use. This represents best practice for dust control and a control factor of 100% has been assumed (DSEWPC, 2012).

Vehicle Speeds

The vehicle speeds on the haul road are controlled at Myuna Colliery and will not exceed 40 km/hr, with the site-wide average speed estimated to be 20 km/hr. No emission control factor from DSEWPC (2012) is applicable to vehicle speed restrictions, although it is noted that the use of a sealed (and swept) road represents maximum possible emission control.

Water Sprays and Enclosure of CHP and Conveyors

The CHP is enclosed and water sprays are used on major transfer points. Emission control factors are quoted in DSEWPC (2012), and include:

- 70% for enclosure; and,
- 90% for use of water sprays with chemicals.

For this assessment a control factor of 70% has been assumed.

Watering of Active Stockpiles

Watering is the principal means of dust suppression for active stockpile areas at Myuna Colliery, which is reported in the literature to provide a control factor of 50% (DSEWPC, 2012). As noted previously, the Emergency Coal Stockpile Area is only used in the event that coal cannot be sent directly to Eraring Power Station via the overland conveyor.

Summary of Control Factors Assumed

A summary of the existing control measures identified as currently being implemented at Myuna Colliery is provided in **Table 11**. These controls will also be implemented as part of the proposed Project operation.

Table 11 Control Factors Assumed for Existing Control Measures

Dust Mitigation Measure	Applied Control Factor	Notes
Induction training	NA	No quantification can be made
Modification of operations in unfavourable weather conditions	NA	No quantification can be made
Sealing of haul roads	100%	-
Vehicle speed restrictions	NA	No quantification can be made
Servicing of water carts	NA	No quantification can be made
Use of additional water trucks as required around CHP and Emergency Coal Stockpile	NA	No quantification can be made
Cleaning up coal spillage at CHP	NA	No quantification can be made
Water sprays and enclosure of conveyor transfer points and Breaker/Crusher/Screen	70%	-
Watering of Emergency Coal Stockpile when in use	50%	Also applied to other operations at the Emergency Coal Stockpile: Truck unloading to ROM stockpile; Front end loader on coal; and, Loading coal to truck:

5.3 Calculation of Particulate Emissions

Based on the activity data for each source presented in **Table 10**, emissions of TSP, PM₁₀ and PM_{2.5} have been calculated for each source for each scenario. Emission controls have been applied to each source as outlined in **Section 5.2.1**.

Particulate emissions from the operational activities have been calculated using default or calculated emission factors for the relevant emission sources. Emission factors were sourced from the National Pollutant Inventory (NPI) *Emission Estimation Technique Manual (EETM) for Mining* version 3.1 (DSEWPC, 2012), or from the US EPA AP-42 Emission Factor Handbook (US EPA, 2006 and 2011) where suitable factors do not exist within the NPI documentation.

The NPI *EETM for Mining* (DSEWPC 2012) and US EPA AP 42 contain emission factors for TSP and PM₁₀. No emission factors for PM_{2.5} are provided within the NPI *EETM for Mining* and only limited emission factors for PM_{2.5} are provided in US EPA AP 42.

Limited research has been undertaken to assess the fraction of PM₁₀ from the wide range of sources which would be emitted as PM_{2.5}. Research has been conducted by the Midwest Research Institute (MRI) on behalf of the Western Regional Air Partnership (WRAP) with findings published within the document entitled '*Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors*' (MRI 2006). This document provides six proposed PM_{2.5}/PM₁₀ ratios for fugitive dust source categories as presented in **Table 12**.

Table 12 Proposed Particle Size Ratios for AP-42

Fugitive Dust Source	AP-42 Section	Proposed PM _{2.5} /PM ₁₀ Ratio
Paved roads	13.2.1	0.15
Unpaved roads (public & industrial)	13.2.2	0.1
Aggregate handling and storage piles	13.2.4	0.1
Industrial wind erosion	13.2.5	0.15
Agricultural tilling	-	0.2
Open area wind erosion	-	0.15

The PM_{2.5} / PM₁₀ ratios presented in **Table 12** have been used within this assessment to calculate the emissions of PM_{2.5} attributable to the Project operations. The most appropriate ratio has been applied to each of the sources.

The emission factors used for the estimation of TSP, PM₁₀ and PM_{2.5} emissions from the operational activities are presented in **Table 14**.

Emissions of particulate matter and odour from the operation of the upcast ventilation fans have been quantified using actual measurements of the particulate and odour emissions from the ventilation fans at the Mandalong Mine Access Site in 2012. The monitoring of particulate and odour emissions was undertaken during a period of normal underground mining operations. The results of the monitoring of the ventilation fans at the existing Mandalong Mine Access Site have been adopted to assess potential impacts from the existing ventilation fans at the Myuna Colliery Surface Site.

Specifically, to estimate emissions from the ventilation fans, a monitoring program was conducted by SLR at the Mandalong Mine Access Site in June 2012 and August 2012 (SLR 2012a and SLR 2012b respectively). The pollutant emissions that were monitored were:

- TSP;
- PM₁₀;
- PM_{2.5}; and,
- Odour.

The monitored emissions from ventilation fans (SLR 2012b) are shown in **Table 13**.

Table 13 Monitored Pollutant Emissions from the Ventilation Fans at the Mandalong Mine

Pollutant	Emission Rate	Units
TSP ¹	0.99	g/s
PM ₁₀ ¹	0.16	g/s
PM _{2.5} ¹	0.17	g/s
Odour ²	30,282	OU.m ³ /s

¹ Source: SLR 2012b

² Source: SLR 2012a, the average of three samples is adopted as the odour emission rate.

Volumetric flow rates measured at the Mandalong Mine Access Site ventilation fans were 136.8 m³/s (SLR, 2012b).

Information from Centennial regarding the volumetric flow rate experienced at the Myuna Colliery Surface Site ventilation fans indicates that the average flow rate per fan is 153 m³/s (306 m³/s in total through 2 fans). Emissions of particulate matter and odour have therefore been scaled to reflect the higher volumetric flow rate experienced at the Myuna Colliery.

Table 14 Summary of Emission Factors Used to Estimate Uncontrolled Emissions

Activity	Emission Factor Equation	Units ¹	Variables ²	Emission Controls Applied to Source	Source of Emission Factor
Conveyor: 1) UG conveyor to ROM bin 2) ROM bin to breaker 3) Breaker to screen 4) Coarse Reject conveyor 5) Screen to crusher 6) Crusher to finished product bin 7) Finished product bin to Eraring overland conveyor	$EF = k \times 0.74 \times 0.016 \times \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$	kg/t	k = 0.74 (TSP) k = 0.35 (PM ₁₀) k = 0.035 (PM _{2.5}) U = mean wind speed (m/s) M = Moisture content (%)	70% - (DSEWPC, 2012) refer Table 11	Miscellaneous Transfer Points (including conveying) NPI EETM Mining v3.1 (DSEWPC 2012) MRI 2006
Coal breaking	$EF_{TSP} = 0.00060$	kg/t	n/a	Tertiary crushing (controlled) ³	US EPA AP42 Chapter 11.19.2 (USEPA 2004)
Coal crushing	$EF_{PM10} = 0.00027$ $EF_{PM2.5} = 0.00005$				
Coal screening	$EF_{TSP} = 0.0011$ $EF_{PM10} = 0.00037$ $EF_{PM2.5} = 0.000025$	kg/t	n/a	Screening (controlled) ³	US EPA AP42 Chapter 11.19.2 (USEPA 2004)
Coal handling: 1) ROM bin to truck loading 2) truck unloading to reclaim bin	$EF = k \times 0.74 \times 0.016 \times \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$	kg/t	k = 0.74 (TSP) k = 0.35 (PM ₁₀) k = 0.035 (PM _{2.5}) U = mean wind speed (m/s) M = Moisture content (%)	No control	Miscellaneous Transfer Points (including conveying) NPI EETM Mining v3.1 (DSEWPC 2012) MRI 2006
Trucks unloading coal at emergency stockpile	$EF = k \times 0.74 \times 0.016 \times \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$	kg/t	k = 0.74 (TSP) k = 0.35 (PM ₁₀) k = 0.035 (PM _{2.5}) U = mean wind speed (m/s) M = Moisture content (%)	50% - (DSEWPC, 2012) refer Table 11	Miscellaneous Transfer Points (including conveying) NPI EETM Mining v3.1 (DSEWPC 2012)

Activity	Emission Factor Equation	Units ¹	Variables ²	Emission Controls Applied to Source	Source of Emission Factor
Hauling of coal to/from the emergency stockpile area	$EF = 0.281 \times k \times \left(\frac{s}{12}\right)^a \times \left(\frac{W}{3}\right)^b$	kg/VKT	k = 4.9 (TSP) k = 1.5 (PM ₁₀) k = 0.15 (PM _{2.5}) a = 0.7 (TSP) a = 0.9 (PM ₁₀) a = 0.9 (PM _{2.5}) b = 0.45 (TSP, PM ₁₀ , PM _{2.5}) s = silt content (%) W = average weight of the vehicles traveling the road (tonnes)	100% - (DSEWPC, 2012) refer Table 11	AP42 Chapter 13.2.2 (unpaved roads)
Front end loader on coal at the emergency stockpile area	$EF_{TSP} = \frac{0.580}{M^{1.2}}$	kg/t	M = Moisture content (%)	50% - (DSEWPC, 2012) refer Table 11	Front end loader on coal NPI EETM Mining v3.1 (DSEWPC 2012)
Loading trucks with front end loader	$EF_{PM10} = \frac{0.75 \times 0.0596}{M^{0.9}}$ $EF_{PM2.5} = 0.019 \times EF_{TSP}$				MRI 2006
Erosion of material on emergency coal stockpile and dam areas	$EF_{TSP} = 0.4$ $EF_{PM10} = 0.2$ $EF_{PM2.5} = EF_{PM10} \times 0.1$	kg/ha/hr	n/a	50% - (DSEWPC, 2012) refer Table 11 on emergency stockpile only.	Wind erosion NPI EETM Mining v3.1 (DSEWPC 2012) MRI 2006

Note 1: kg/t = kilogram per tonne, kg/VKT = kilogram per vehicle kilometre travelled, kg/ha/hr = kilogram per hectare per hour

Note 2: Refer to **Table 10** for assumptions used in emissions calculations

Note 3: Controlled sources (with wet suppression) are those that are part of the processing plant that employs current wet suppression technology

6 AIR DISPERSION MODELLING METHODOLOGY

6.1 Model Selection

Emissions from the Project operations have been modelled using the US EPA's CALPUFF (Version 6.267) modelling system. CALPUFF is a transport and dispersion model that ejects "puffs" of material emitted from modelled sources, simulating dispersion and transformation processes along the way. In doing so it typically uses the fields generated by a meteorological pre-processor CALMET, discussed further below. Temporal and spatial variations in the meteorological fields selected are explicitly incorporated in the resulting distribution of puffs throughout a simulation period. The primary output files from CALPUFF contain either hourly concentration or hourly deposition fluxes evaluated at selected receptor locations. The CALPOST post-processor is then used to process these files, producing tabulations that summarise results of the simulation for user-selected averaging periods.

The advantages of using CALPUFF (rather than using a steady state Gaussian dispersion model such as AUSPLUME) is its ability to handle calm wind speeds (<0.5 m/s) and the effects of complicated terrain on plume dispersion. Steady state models assume that meteorology is unchanged by topography over the modelling domain and may result in significant over or under estimation of air quality impacts.

More advanced dispersion models (such as CALPUFF) are approved for use by many regulatory authorities in situations where these models may be more appropriate than use of steady-state Gaussian models, such as AUSPLUME. Such situations include those noted above (i.e. high frequency of calm wind conditions and/or complicated terrain).

6.2 Meteorological Modelling

6.2.1 Meteorological Modelling Approach

To adequately characterise the dispersion meteorology of the Project Application Area, information is needed on the prevailing wind regime, ambient temperature, rainfall, relative humidity, mixing height and atmospheric stability. The meteorology of the study area was characterised based on a 3-Dimensional prognostic meteorological dataset for the region surrounding the Project Application Area.

MM5

The three dimensional prognostic dataset generated by the Pennsylvania State University/National Centre for Atmospheric Research, or MM5, model was created and assimilated in the CALMET modelling process. The MM5 model is a prognostic mesoscale wind field model with four-dimensional data assimilation. CALMET's wind model allows MM5 generated data to be used as initial pseudo-observations (Scire *et al.*, 2006).

For this study, an MM5 meteorological dataset was obtained for a 120 km x 120 km domain for the 2010 calendar year, centred over the study area, with a spatial grid resolution of 12 km. 2010 was selected as the appropriate modelling assessment meteorology data to maintain consistency with all other Centennial EIS studies.

The model has 40 vertical levels, with the lowest level beginning at 11 m above ground level ranging to 3,500 m. The MM5 dataset contains the two-dimensional and three-dimensional parameters listed in **Table 15**.

Table 15 MM5 Dataset Parameters

Hourly 3-Dimensional Parameters	Hourly 2-Dimensional Parameters
Wind speed and direction	Sea-level pressure
Temperature	Rainfall amount
Pressure	Snow cover
Geopotential height	Short wave and long wave radiation at the surface
Vertical velocity	Air temperature and specific humidity at 2m
Relative humidity	Wind speed and direction at 10m
Mixing ratios for water vapour, cloud water, rain and other precipitation	Sea surface temperature

CALMET

CALMET is a meteorological model that develops wind and temperature fields on a three-dimensional gridded modelling domain. Associated two-dimensional fields such as mixing height, surface characteristics, and dispersion properties are also included in the file produced by CALMET. The interpolated wind field is then modified within the model to account for the influences of topography, as well as differential heating and surface roughness associated with different land uses across the modelling domain. These modifications are applied to the winds at each grid point to develop a final wind field. The final wind field thus reflects the influences of local topography and land uses.

Table 16 details the parameters used in the meteorological modelling. No surface, upper air or buoy observations were used in the CALMET model ('No-Obs Mode' hereafter). This approach is recommended by NSW EPA (2010) as:

- No-Obs mode allows the important benefits of the non-steady-state approach in CALPUFF to be included in the dispersion modelling (e.g., spatially varying meteorology and dispersion, causality, recirculation, stagnation, pollutant build-up, fumigation, etc.);
- No-Obs mode makes use of three-dimensional, hourly prognostic meteorological data often available at high resolution to drive CALMET and CALPUFF;
- No-Obs mode greatly simplifies the preparation of the CALMET inputs because a large number of input variables dealing with observational data are not required and the difficulties of dealing with potentially incomplete observational datasets are eliminated; and
- No-Obs mode provides a relatively straightforward approach that facilitates agency review and approval of the CALMET/CALPUFF simulations;

Table 16 CALMET Configuration Used for this Study

Meteorological grid domain	40 km x 40 km
Meteorological grid resolution	0.3 km
TERRAD Value	1.5 km
Vertical Resolution (Cell Heights)	10 (0 m, 20 m, 40 m, 80 m, 160 m, 320 m, 640 m, 1,200 m, 2,000 m, 3,000 m and 4,000m)
Modelling Year	2010

6.2.2 Meteorological Data Used in Modelling

Wind Speed and Direction

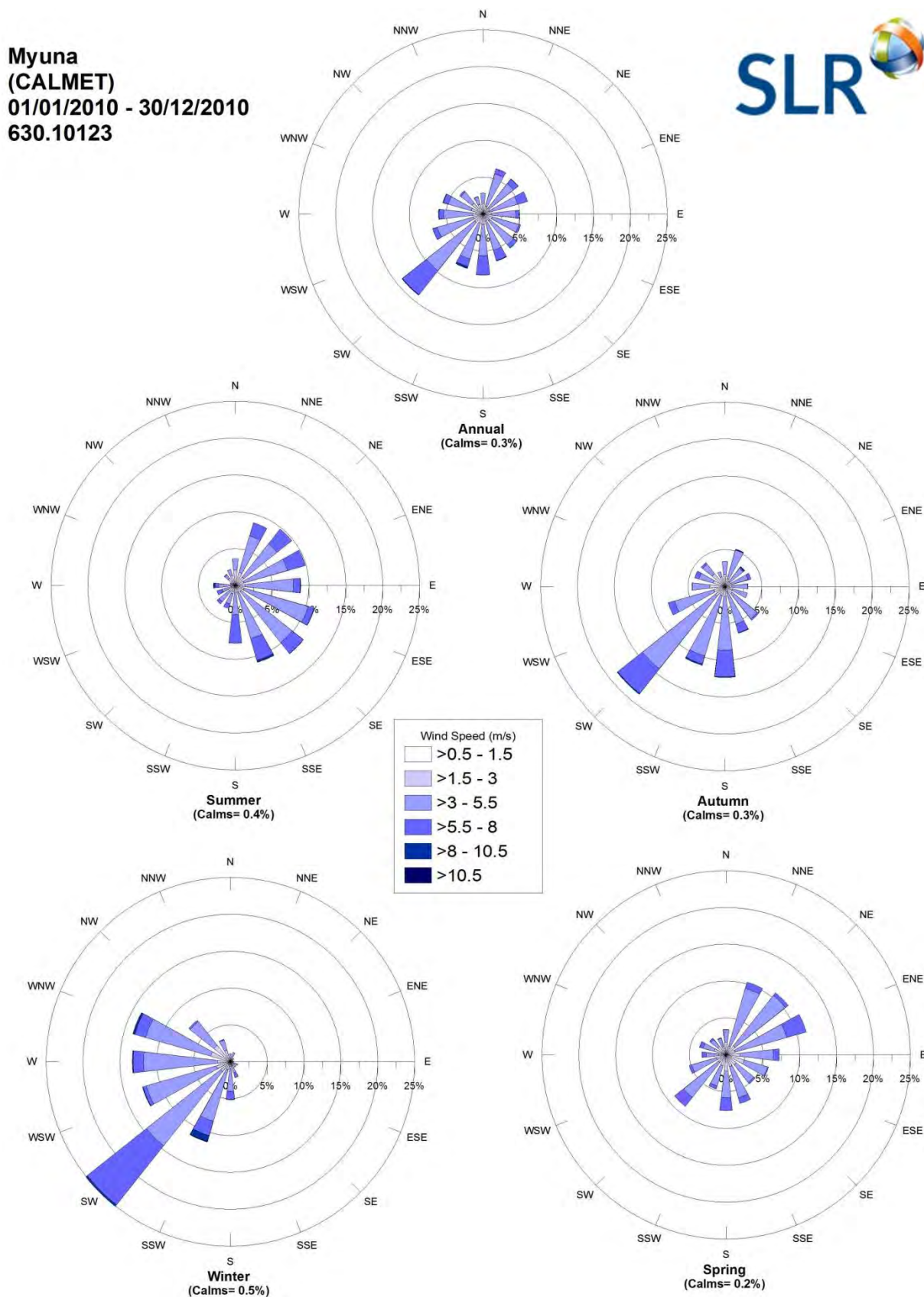
A summary of the annual wind behaviour predicted by CALMET for the Project for the year 2010 is presented as wind roses in **Figure 4**.

These wind roses indicate that the region predominantly experiences light to moderate (between 1.5 m/s and 8 m/s) winds with high speed winds (> 8m/s) prevailing for a low fraction of time during the year. Winds occur reasonably evenly from southwest and east-northeast quadrants.

The seasonal wind roses indicated that typically:

- In summer, winds are light to moderate predominantly from between north northeast and south quadrant (approximately 80% combined), with low frequency of winds from between south southwest and north quadrants;
- In autumn, winds are light to moderate predominantly from the southwest quadrant (approximately 40% combined);
- In winter, winds are mostly light to moderate and are experienced predominantly from between south southwest to northwest quadrants (approximately 85% combined) with a low frequency of high winds (>8 m/s) from south southwest and west northwest; and
- In spring, winds are light to moderate from between north northeast and east northeast (approximately 33% combined).

Figure 4 Annual Wind Roses for –Myuna (CALMET predictions, 2010)



Atmospheric Stability

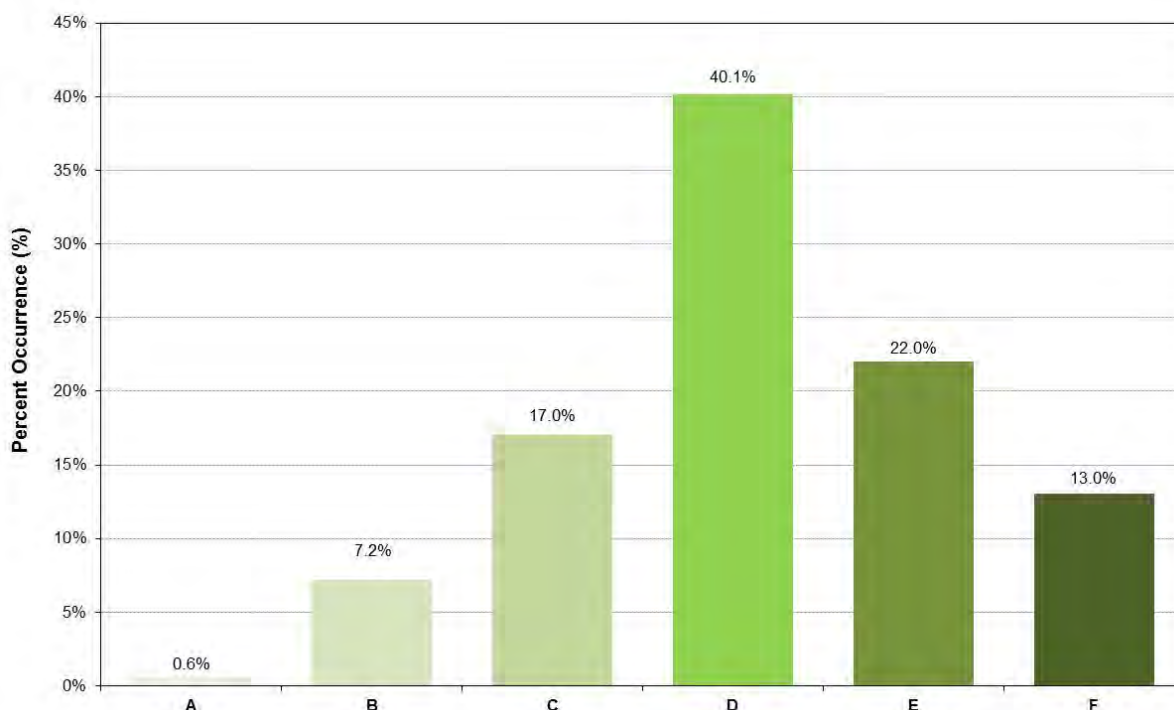
Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical motion. The Pasquill-Turner assignment scheme identifies six Stability Classes, A to F, to categorise the degree of atmospheric stability (see **Table 17**). These classes indicate the characteristics of the prevailing meteorological conditions and are used as input into various air dispersion models.

The frequency of each stability class predicted by CALMET at the Project site during 2010 is presented in **Figure 5**. The results indicate a high frequency of conditions typical to Stability Class D. Stability Class D is indicative of neutral conditions, conducive to a moderate level of pollutant dispersion due to mechanical mixing.

Table 17 Description of Atmospheric Stability Classes

Atmospheric Stability Class	Category Description
A	Very unstable low wind, clear skies, hot daytime conditions
B	Unstable clear skies, daytime conditions
C	Moderately unstable moderate wind, slightly overcast daytime conditions
D	Neutral high winds or cloudy days and nights
E	Stable moderate wind, slightly overcast night-time conditions
F	Very stable low winds, clear skies, cold night-time conditions

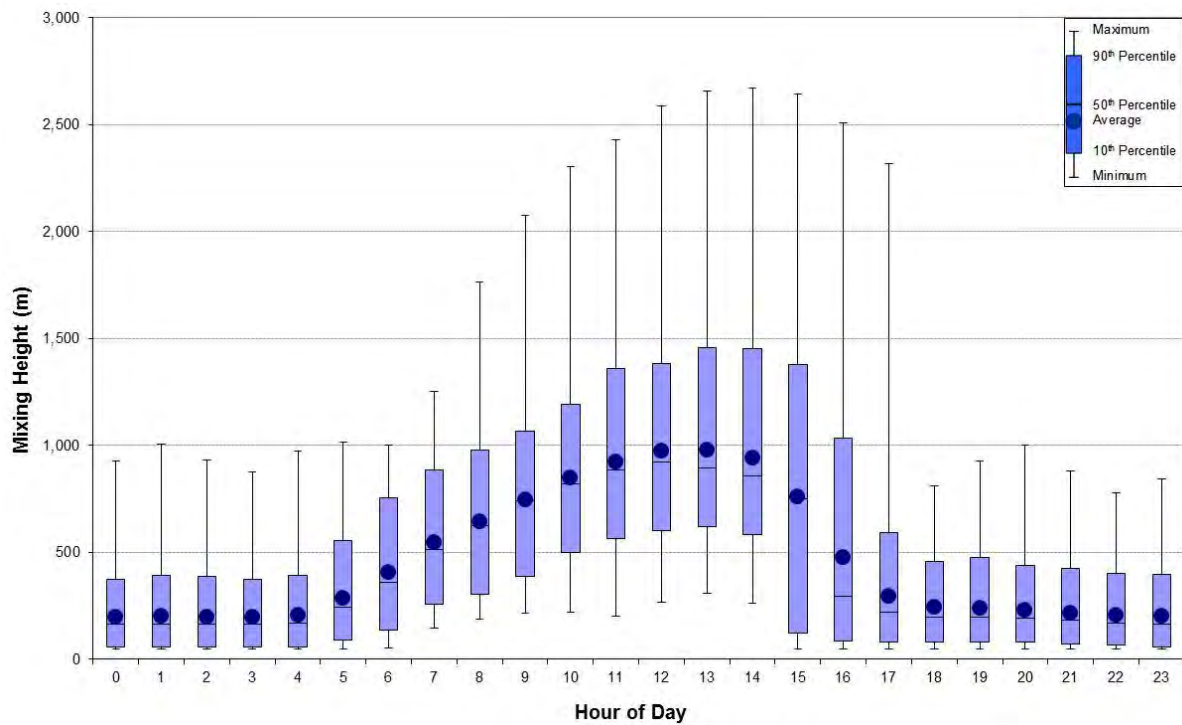
Figure 5 Stability Class Frequencies for Myuna (CALMET predictions, 2010)



Mixing Heights

Diurnal variations in maximum and average mixing heights predicted by CALMET at the Project site during 2010 are illustrated in **Figure 6**. As would be expected, an increase in the mixing height during the morning is apparent, arising due to the onset of vertical mixing following sunrise. Maximum mixing heights occur in the mid to late afternoon, due to the dissipation of ground-based temperature inversions and the growth of the convective mixing layer.

Figure 6 Mixing Heights for Myuna (CALMET predictions, 2010)



6.2.3 Compatibility of Modelled Meteorological Data to Other Assessments

This section describes compatibility of modelled meteorological data (refer to **Section 6.2**) for air quality impact assessments to other assessments such as the noise & vibration assessment.

Whilst the starting point for each assessment may be similar, the requirements for meteorological data vary as stated in guidance documentation from the appropriate regulatory authorities.

The meteorological dataset developed for use in the air quality impact assessment has been compiled to provide a robust and conservative assessment of potential downwind impacts due to particulate and other pollutant emissions from activities occurring within Myuna Colliery. The factors considered in selecting the meteorological data for use in an air quality impact assessment can be considerably different to those that need to be considered when compiling data for a noise impact assessment, or even an air quality impact assessment which is addressing other issues, such as the potential for odour nuisance impacts.

For example, impacts resulting from particulate emissions tend to be greatest under moderate to strong wind speeds, when wind-blown dust is generated and particulate matter can be carried significant distances before settling out of the air. In comparison, worst-case noise and odour impacts tend to occur under calm wind conditions when there is little atmospheric turbulence to dissipate the noise/odours.

Dust impacts are also assessed based on longer term averages (24-hour and annual averages), whereas noise and odour nuisance impacts are more likely to be associated with peak events.

Also, the dataset as a whole is required to contain different meteorological parameters to assess the noise impacts or air quality impacts. For example, for air quality impacts, the mixing heights in the dataset are required to assess the potential limits for the vertical dispersion of pollutants which can have a significant impact on the resultant ground level concentration at the discrete receptors. Whereas for noise impacts, the mixing heights do not directly influence the noise impacts experienced.

For these reasons, the meteorological data used in this assessment is likely to differ from that used in the assessment of noise impacts from the site and possibly incompatible with the modelled meteorological data for the noise and vibration assessment.

7 EXISTING AIR QUALITY

The air quality in the region surrounding the Myuna Colliery is influenced by emissions generated by a range of sources, originating from both within and outside of the local area. Specifically, for the area surrounding the Myuna Colliery, air quality will be influenced by pollution transported into the area from more distant sources, emissions from power stations in the area, traffic-generated pollution and pollution generated by the Project itself.

To determine the *incremental* impact of particulate emissions from the Project on the surrounding environment and sensitive receptors, a dispersion modelling exercise has been performed.

To appropriately assess the *cumulative* impact of the Project, the incremental impact needs to be added to a dataset which includes the contributions of all other significant sources of particulate in the region. Given that air quality monitoring locations in the local area are limited to those close to major particulate sources (such as mine sites) the use of an alternative dataset has been investigated to avoid possible double-counting of Project-related emissions.

This section outlines the methodology used to generate the background pollutant dataset used in this assessment. It involves the following steps:

- 1 Selection of an appropriate background dataset representative of regional air quality without the influence of major industrial sources in the local area (i.e. power stations and Project-related emissions) – **Section 7.1**;
- 2 Addition of an appropriate incremental contribution to ambient particulate levels due to controlled process and fugitive emissions from power stations in the local area (such as Eraring, Munmorah and Vales Point power stations) – **Section 7.2**; and,
- 3 Assessment of an appropriate incremental contribution (if any) to ambient particulate levels due to controlled process and fugitive emissions from other mining and ancillary operations in the local area (such as the Northern Coal Logistics Project) – **Section 7.3**.

7.1 Regional Background Air Quality

7.1.1 Particulates (PM₁₀ and PM_{2.5})

Particulate data (PM₁₀ and PM_{2.5}) from three NSW EPA air quality monitoring stations (AQMS) were obtained to assist in the determination of the background particulate environment excluding the impacts of power stations and Project-related sources. Data for the years 2006, 2007, 2008, 2009 and 2010 (concurrent with the meteorological modelling performed) was obtained for Newcastle AQMS, Beresfield AQMS and Wallsend AQMS. PM_{2.5} is not monitored at the EPA Newcastle AQMS. The locations of these three sites are presented in **Figure 2**.

Statistics for each site for each of the three years are presented in **Table 18**, **Table 19** and **Table 20**. All data is presented as 24-hour average concentrations in µg/m³, except averaging period (hours), skew and kurtosis (dimensionless) and data capture (percentage of the monitoring period). Presented in **Figure 7** and **Figure 8** are time series plots for PM₁₀ and PM_{2.5}, respectively.

It is noted that on 23 September 2009, a dust storm was experienced in the region (DECC 2009), resulting in very high 24 hour averages for PM₁₀ and PM_{2.5}. The recorded concentrations shown in **Figure 7** and **Figure 8** include the concentrations recorded on 23 September 2009 but the graphs have been truncated at appropriate levels to show the variations.

Figure 7 24-hour Average PM₁₀ Concentrations Measured at NSW EPA Beresfield, Wallsend and Newcastle AQMS (2006 – 2010)

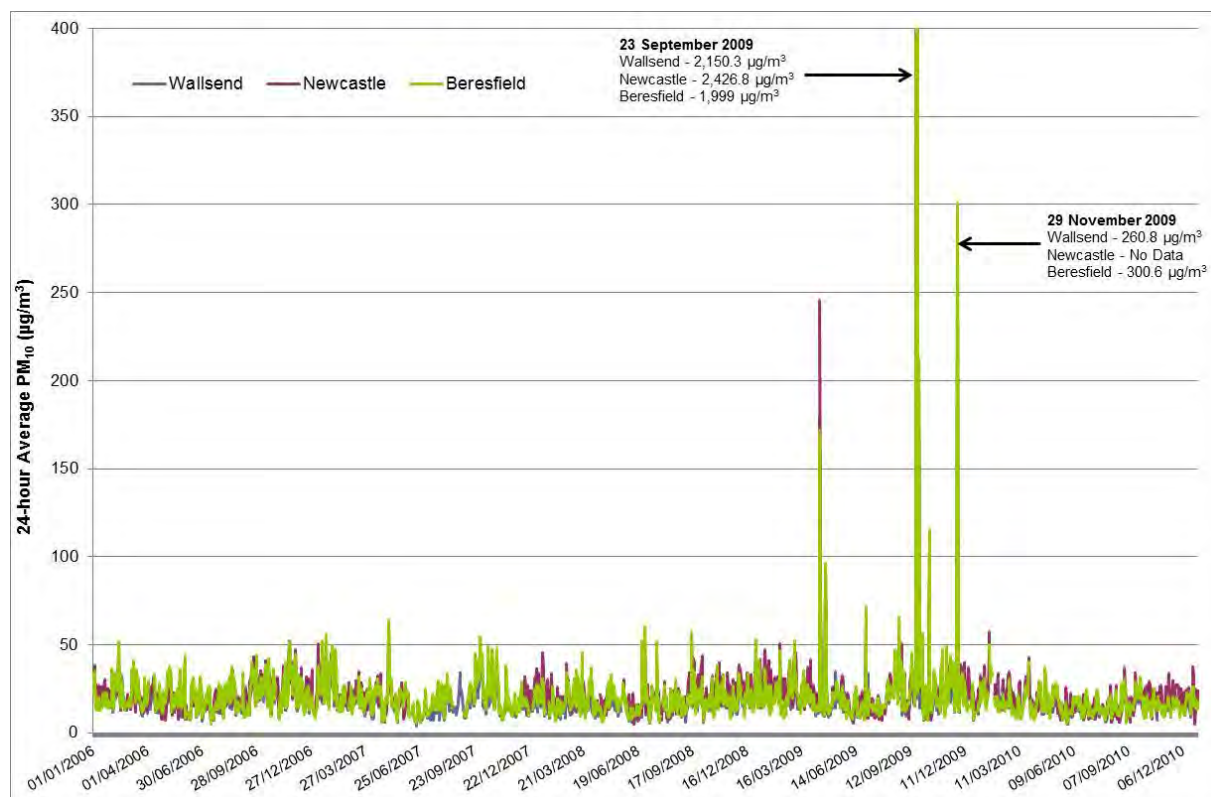


Figure 8 24-hour Average PM_{2.5} Concentrations Measured at NSW EPA Beresfield and Wallsend AQMS (2006 – 2010)

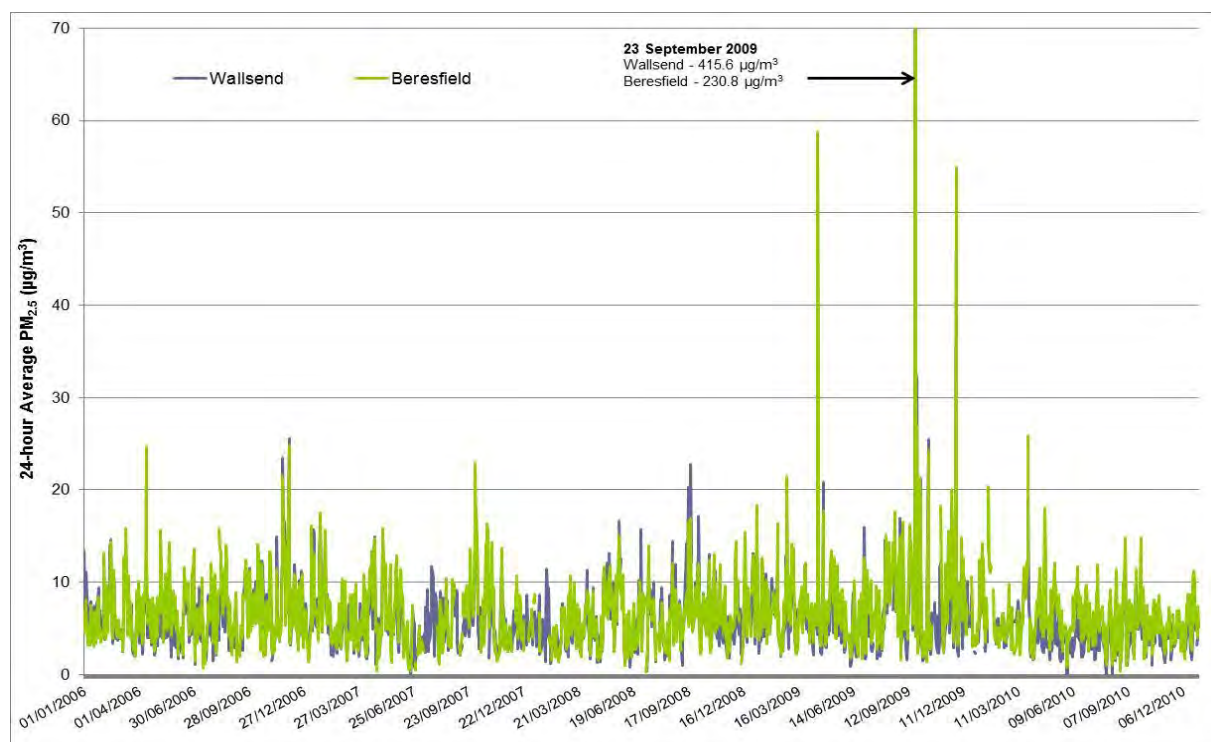


Table 18 Statistical Summary of Wallsend AQMS Background Monitoring Data

Statistic	2006		2007		2008		2009		2010	
	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Averaging Period	24-hour	24-hour	24-hour	24-hour	24-hour	24-hour	24-hour	24-hour	24-hour	24-hour
Data Points	359	362	341	337	303	320	333	323	318	338
Mean (µg/m ³)	18.6	6.4	17.4	5.8	15.7	5.8	19.9	6.8	14.7	4.6
Standard Deviation (µg/m ³)	± 7.1	± 3.3	± 7.4	± 3.2	± 6.4	± 3.4	±15.6	±5.3	±4.7	±2.3
Skew ¹	+1.1	+1.5	+1.4	+1.0	+2.0	+1.4	+6.7	+4.1	+0.7	+1.4
Kurtosis ²	+2.0	+4.9	+2.9	+1.0	+7.5	+3.4	+61.3	+27.6	+0.6	+4.7
Minimum (µg/m ³)	5.6	1.1	3.6	-0.1	5.0	0.1	6.9	0.9	5	-0.2
Percentiles (µg/m³)										
25 th	13.6	4.0	12.7	3.3	11.8	3.4	12.7	3.9	11.4	3.1
50 th	17.4	5.9	16.0	5.1	14.8	5.2	16.5	5.6	14.0	4.2
75 th	22.7	8.1	20.8	7.5	18.6	7.4	23.2	8.4	17.7	5.7
90 th	27.5	10.5	26.5	10.0	23.2	10.0	31.0	12.4	20.8	7.4
95 th	31.4	11.9	33.3	12.2	26.4	11.9	35.1	14.3	23.6	9.0
97 th	34.2	13.5	35.0	13.9	30.1	13.0	38.2	16.9	25.3	10.1
98 th	35.8	14.4	36.7	14.8	31.9	14.3	54.8	18.7	26.5	10.7
99 th	40.7	15.5	40.0	15.2	39.9	17.0	73.1	24.6	28.0	11.7
Maximum 1 (µg/m ³)	52.0	25.6	50.9	18.2	56.5	22.8	179.5	50.5	32.8	18.8
Maximum 2 (µg/m ³)	45.3	23.5	50.8	15.7	43.6	20.3	173.9	49.8	29.5	13.7
Maximum 3 (µg/m ³)	45.1	18.4	46.5	20.3	43.0	19.6	81.1	32.3	28.6	12.0
Data Capture	98.4%	99.2%	93.4%	92.3%	82.8%	87.4%	90.4%	87.0%	85.2%	92.0%

- Notes 1 Skew represents an expression of the distribution of measured values around the derived mean. Positive skew represents a distribution tending towards values higher than the mean, and negative skew represents a distribution tending towards values lower than the mean. Skew is dimensionless.
- 2 Kurtosis represents an expression of the value of measured values in relation to a normal distribution. Positive skew represents a more pointed distribution, and negative skew represents a distribution more flattened than a normal distribution. Kurtosis is dimensionless.

Table 19 Statistical Summary of Beresfield AQMS Background Monitoring Data

Statistic	2006		2007		2008		2009		2010	
	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Averaging Period	24-hour	24-hour	24-hour	24-hour	24-hour	24-hour	24-hour	24-hour	24-hour	24-hour
Data Points	352	361.0	329	314	349	336	358	341	318	338
Mean (µg/m ³)	21.2	6.8	20.4	6.3	18.4	5.9	22.7	7.9	14.7	4.6
Standard Deviation (µg/m ³)	± 8.7	± 3.5	± 10.0	± 3.7	± 7.9	± 3.0	±17.7	±5.6	±6.3	±3.1
Skew ¹	+0.8	+1.5	+1.4	+1.1	+1.8	+0.8	+6.0	+4.4	+0.7	+1.4
Kurtosis ²	+0.2	+4.0	+2.4	+1.4	+5.8	+0.8	+51.2	+32.9	+0.6	+4.7
Minimum (µg/m ³)	4.8	0.7	5.7	0.3	5.8	0.2	7.2	1.4	5	-0.2
Percentiles (µg/m³)										
25 th	14.6	4.3	13.1	3.5	13.4	3.6	14.2	4.8	11.4	3.1
50 th	18.8	5.9	18.4	5.5	16.9	5.7	18.4	6.6	14.0	4.2
75 th	26.6	8.6	25.2	8.4	21.5	7.6	26.1	9.6	17.7	5.7
90 th	34.1	11.3	32.0	11.5	27.2	9.6	35.1	13.4	20.8	7.4
95 th	36.7	13.3	41.3	13.6	32.1	11.5	46.3	15.7	23.6	9.0
97 th	39.1	14.1	47.7	14.6	34.5	12.1	53.1	18.1	25.3	10.1
98 th	42.1	15.2	49.1	15.7	36.9	13.7	65.4	20.3	26.5	10.7
99 th	44.1	16.5	53.8	16.9	52.1	14.8	82.0	25.9	28.0	11.7
Maximum 1 (µg/m ³)	51.9	24.9	64.0	23.0	59.9	16.9	211.4	58.8	32.8	18.8
Maximum 2 (µg/m ³)	51.4	24.7	57.9	17.9	57.6	16.6	171.8	55.0	29.5	13.7
Maximum 3 (µg/m ³)	46.3	21.6	56.2	17.5	53.1	15.4	115.2	28.1	28.6	12.0
Data Capture	96.4%	98.9%	90.1%	86.0%	95.4%	91.8%	98.0%	93.0%	85.2%	92.0%

- Notes 1 Skew represents an expression of the distribution of measured values around the derived mean. Positive skew represents a distribution tending towards values higher than the mean, and negative skew represents a distribution tending towards values lower than the mean. Skew is dimensionless.
- 2 Kurtosis represents an expression of the value of measured values in relation to a normal distribution. Positive skew represents a more pointed distribution, and negative skew represents a distribution more flattened than a normal distribution. Kurtosis is dimensionless.

Table 20 Statistical Summary of Newcastle AQMS Background Monitoring Data

Statistic	2006	2007	2008	2009	2010
	PM ₁₀	PM ₁₀	PM ₁₀	PM ₁₀	PM ₁₀
Averaging Period	24-hour	24-hour	24-hour	24-hour	24-hour
Data Points	355	172	341	339	365
Mean (µg/m ³)	21.1	22.8	20.5	24.9	17.9
Standard Deviation (µg/m ³)	±7.4	±8.9	±7.9	±19.3	±7.9
Skew ¹	+0.7	+1.2	+0.9	+7.4	+0.5
Kurtosis ²	+0.8	+2.5	+1.2	+75.3	+2.0
Minimum (µg/m ³)	6.5	6.1	4.9	5.6	0.0
Percentiles (µg/m³)					
25 th	15.8	17.2	15.1	16.5	13.2
50 th	20.5	21.6	19.1	22.3	17.4
75 th	25.6	26.8	24.6	27.8	22.8
90 th	30.7	33.4	31.1	36.1	27.1
95 th	34.1	39.2	34.3	43.1	30.1
97 th	36.1	43.4	38.1	50.7	33.8
98 th	38.0	47.8	39.2	60.3	34.6
99 th	42.0	52.4	43.1	80.8	37.6
Maximum 1 (µg/m ³)	51.2	58.1	54.4	245.4	57.1
Maximum 2 (µg/m ³)	47.2	57.2	50.6	211.6	48.3
Maximum 3 (µg/m ³)	43.3	50.4	45.6	86.6	42.5
Data Capture	97.3%	47.1%	93.2%	92.3%	100.0%

- Notes 1 Skew represents an expression of the distribution of measured values around the derived mean. Positive skew represents a distribution tending towards values higher than the mean, and negative skew represents a distribution tending towards values lower than the mean. Skew is dimensionless.
- 2 Kurtosis represents an expression of the value of measured values in relation to a normal distribution. Positive skew represents a more pointed distribution, and negative skew represents a distribution more flattened than a normal distribution. Kurtosis is dimensionless.

The statistics presented in **Table 18**, **Table 19** and **Table 20** indicate that in general, higher concentrations of PM₁₀ and PM_{2.5} are measured at the Beresfield AQMS when compared with Wallsend AQMS. Also, higher concentrations of PM₁₀ are measured at Newcastle AQMS when compared with Wallsend AQMS.

This is unsurprising given the location of the Newcastle AQMS site in an urban location, with a not insignificant contribution to particulate concentrations from vehicle traffic and industrial sources located in the area. The Beresfield AQMS is also located near to a major road and the influence from vehicle traffic in the particulate monitoring record will be observed.

Data from the Wallsend AQMS shows lower maximum concentrations and lower annual average particulate concentrations than the other two sites in the area. The Wallsend AQMS is located approximately 9 km from the urban centre of Newcastle and although it will experience some contribution from vehicle traffic, the impact will not be as significant as that experienced within Newcastle. Additionally, impacts from industry will be markedly lower at Wallsend.

Based on the statistical analysis and discussion of the particulate monitoring data for the three stations, it is concluded that the use of the Wallsend AQMS PM₁₀ and PM_{2.5} data as a “regional background” dataset is appropriate and valid. The prevailing air quality conditions experienced in the area surrounding the Project Application Area (not considering the effects of nearby power stations or Project activities) is expected to be most similar to those experienced at Wallsend.

Air quality monitoring of PM₁₀ has been performed at the Myuna Colliery since August 2013 using a High Volume Air Sampler (HVAS) operating on a 1-in-6 day cycle. This monitoring is performed to assess the compliance of the Project with Project Approval conditions and is not appropriate to be used as a suitable background dataset for this assessment given that the dataset is not continuous, and it also includes the impact of the Project. However, it is useful to assess the suitability of the adoption of the Wallsend AQMS data as a background dataset for the Project.

Table 21 Comparison of Myuna and Wallsend PM₁₀ data

Date	Myuna Colliery		Wallsend AQMS	
	Average (µg/m ³)	Maximum (µg/m ³)	Average (µg/m ³)	Maximum (µg/m ³)
August 2013 to August 2014 1 in 6 day	14.5	38.0	17.6	46.7
August 2013 to August 2014 Daily	-	-	17.2	52.5
2010 Daily	-	-	14.7	32.8

Measurements of PM₁₀ measured at the Myuna Colliery include the impacts of power station and Project related emissions. During the period August 2013 to August 2014 these measurements indicate generally lower PM₁₀ concentrations were measured at the Myuna Colliery than were measured at the Wallsend AQMS site. The year of assessment for this Project has been selected as 2010, and data measured at Wallsend AQMS during 2010 is lower than that measured at the site during the August 2013 to August 2014 period. It is considered that the use of the Wallsend AQMS dataset for 2010 is appropriate and represents a suitable background air quality dataset for use within this assessment.

7.1.2 TSP

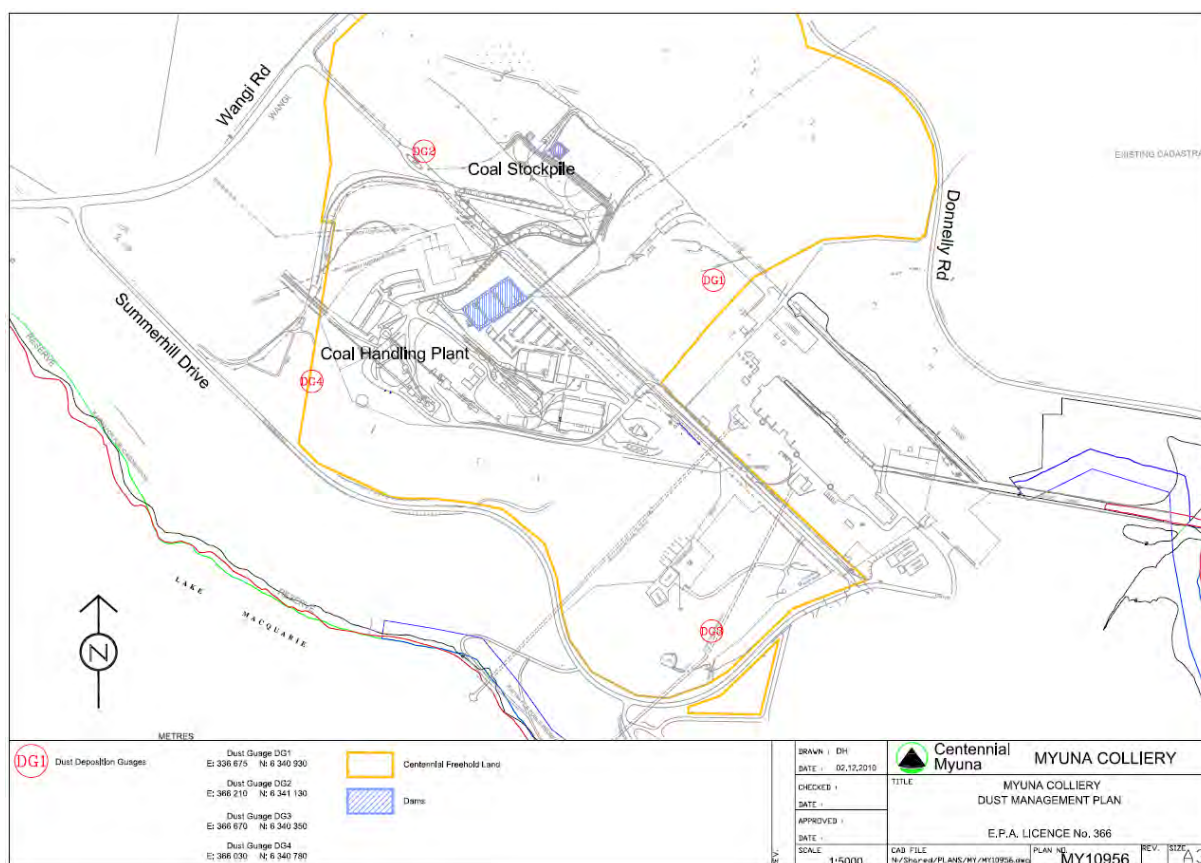
No TSP monitoring is performed by the NSW EPA at any of the three nearby AQMS locations. In this instance, TSP concentrations have been assumed to be twice those of the measured PM₁₀ concentrations at Wallsend AQMS. It is noted that the PM₁₀ sub-set is typically 50% of TSP mass in regions where road traffic is not the dominant particulate source (USEPA, 2001) and therefore a background TSP concentration of 29.4 µg/m³ has been adopted.

TSP monitoring performed on a 1-in-6 day cycle at the Myuna Colliery between August 2013 and August 2014 indicates that the annual average TSP concentration was 29.6 µg/m³ inclusive of power station and Project operations and therefore the adoption of a value of 29.4 µg/m³ is considered to be conservative.

7.1.3 Dust

For dust deposition, no regional background datasets are available for use. CMPL has a current dust deposition monitoring program in place which covers the Myuna Surface Facilities Site. The locations of the dust deposition gauge (DDG) sites relevant to the Project are shown in **Figure 9**.

Figure 9 Locations of Dust Deposition Gauges – Myuna Colliery



Source: Centennial 2012b

A summary of the dust deposition monitoring program is shown in **Table 22**.

Table 22 Summary of the Dust Deposition Monitoring Program at Myuna Colliery

Gauge #	Monitoring Period	Average Deposition Rate (g/m ² /month)
D1	July 2002 – August 2014	0.7
D2	July 2002 – August 2014	1.0
D3	July 2002 – August 2014	1.7
D4	July 2002 – August 2014	1.3
Overall Average		1.2

Source: Centennial 2014

It is noted that the long term average dust deposition rates shown in **Table 22** include the contribution of mining operations and the background dust levels. A conservative dust deposition rate of **2 g/m²/month** is adopted as a background dust deposition rate.

7.1.4 Odour

The monitoring program conducted by SLR Consulting (SLR 2012a) identified the characteristics of the odour from the ventilation fans at the Mandalong Mine as yeast, exhaust and metallic. It is considered that there are no similar odour sources in the vicinity of Myuna Colliery. In the absence of any similar odour sources, the background odour concentration is assumed to be negligible (i.e zero).

7.2 Power Stations

To determine the background particulate concentrations experienced across the domain, the increment from power stations located in the area needs to be added to the regional background particulate concentrations from **Section 7.1**.

A dispersion modelling exercise has been performed using publicly available information to determine the contribution from power station emissions to particulate concentrations within the modelling domain. The information in **Table 23** has been obtained for stack sources associated with Eraring, Vales Point and Munmorah power stations. Emission rates of PM_{2.5} were not publicly available and therefore the WRAPAIR factor (refer **Section 5**) of 0.1 have been applied to the PM₁₀ emission rates for all particulate emissions sources to estimate the rate of PM_{2.5} emissions from these power station sources.

Table 23 Point Source Emissions from Eraring, Munmorah and Vales Point Power Stations

Source	ID	Easting (m)	Northing (m)	Height (m)	Diameter (m)	Temperature (°C)	Velocity (m/s)	TSP (g/s)	PM ₁₀ (g/s)	PM _{2.5} (g/s)
Eraring	ES1	361,938	6,340,750	200	10.5	107	17	64.0	12.7	1.3
Eraring	ES2	361,975	6,340,938	200	10.5	107	17	64.0	12.7	1.3
Munmorah ¹	MS1	364,190	6,324,292	150	7.9	153	19	30.5	30.5	3.1
Vales Point ²	VPS1	364,347	6,329,916	178	11	110	15.4	60.0	12.5	1.3

Notes 1 No information on TSP emissions rate available – taken to be the same as PM₁₀ (equivalent to 50 mg/m³ stack concentration).

2 Vales Point B Station (A Station decommissioned and two associated 138 m stacks now redundant).

The influence of building wake effects on the power station stack emissions has been taken into account in the dispersion modelling. Building dimensions were estimated using Google Earth images and the relationship between known stack heights and associated shadow lengths. This relationship has then been applied to the building shadow lengths to estimate building heights. The building heights used in the modelling assessment are presented in **Table 24**.

Table 24 Details of Building Coordinates and Dimensions at Eraring, Munmorah and Vales Point Power Stations

Site	Building	ID	Easting (m)	Northing (m)	Assumed Height (m)
Eraring	Powerhouse	EB1	361,836	6,341,059	40
			361,985	6,341,040	
			361,924	6,340,658	
			361,783	6,340,675	
Munmorah	Powerhouse	MB1	364,147	6,324,453	42
			364,190	6,324,393	
			364,010	6,324,241	
			363,961	6,324,294	
Vales Point	Powerhouse	VPB1	364,169	6,330,013	39
			364,335	6,330,136	
			364,364	6,330,099	
			364,199	6,329,976	
	Coal units	VPB3	364,239	6,329,993	59
			364,317	6,330,055	
			364,348	6,330,031	
			364,261	6,329,973	

In addition to emissions from stack sources, emissions from coal stockpiles and ash dams have also been considered. The location and surface area of coal stockpiles have been obtained from Google Earth imagery. Heights of all coal stockpiles have been assumed to be 5 m above ground level (AGL). For ash dams, half of the total area observed in Google Earth imagery has been taken to be available for wind erosion. For modelling purposes, the height of the ash dams has been taken to be 0 m AGL.

Emission rates for all stockpiles and ash dams have been taken to be the National Pollutant Inventory (NPI) default for wind erosion of 0.4 kg/ha/hr for TSP and 0.2 kg/ha/hr for PM₁₀ and 0.02 kg/ha/hr for PM_{2.5}. The emission rate for PM_{2.5} has been calculated using the WRAPAIR emission factors as discussed in **Section 5**.

It is acknowledged that the use of the default value may result in under- or over-estimation of 24-hour particulate concentrations at some locations, although taking into account the nature and scale of this assessment and the availability of data to perform alternative methodologies, it is considered to be appropriate.

Details of stockpile and ash dam locations are presented in **Table 25**.

Table 25 Details of Stockpile and Ash Dam Locations at Eraring, Munmorah and Vales Point Power Stations

Site	Stockpile	ID	Easting (m)	Northing (m)	Assumed Height (m)
Eraring	Coal	ESP1	361,715	6,341,677	5
			361,715	6,341,345	
			362,097	6,341,345	
			362,097	6,341,677	
	Coal	ESP2	362,161	6,341,677	5
			361,897	6,341,674	
			361,897	6,341,935	
			362,161	6,341,935	
	Ash Dam	EAD1	363,128	6,342,672	0
			362,915	6,342,178	
			364,080	6,341,921	
			364,142	6,342,278	
Munmorah	Coal	MSP1	364,158	6,324,004	5
			364,374	6,324,048	
			364,418	6,323,861	
			364,226	6,323,811	
Vales Point	Coal	VPSP1	363,648	6,329,355	5
			363,937	6,329,204	
			363,815	6,328,965	
			363,519	6,329,106	
	Coal	VPSP2	364,787	6,329,587	5
			364,852	6,329,562	
			364,760	6,329,398	
			364,700	6,329,429	
	Ash Dam	VPAD1	362,437	6,328,584	0
			363,447	6,327,984	
			362,433	6,326,172	
			361,976	6,327,423	

Through the dispersion modelling exercise, particulate concentrations experienced at each of the identified sensitive receptor locations (refer **Section 3.2**) due to emissions from the power stations have been estimated. Additionally, impacts have also been predicted at the Wallsend AQMS (refer **Section 7.1**) to verify that concentrations of particulate measured at the station do not include a significant contribution from power station related emissions.

The maximum modelled 24-hour average PM₁₀ concentration at the Wallsend AQMS from power station operations was predicted to be 0.8 µg/m³, and it is therefore concluded that the PM₁₀ monitoring data derived from Wallsend AQMS data does not include a significant contribution from power station operations, and that data may be used as a “regional background” dataset for the domain.

The maximum modelled 24-hour average $PM_{2.5}$ concentration at the Wallsend AQMS from power station operations was predicted to be $0.01 \mu\text{g}/\text{m}^3$. It is therefore concluded that the $PM_{2.5}$ monitoring data from Wallsend AQMS does not include a significant contribution from power station operations and therefore the data can be used as a “regional background” dataset for the domain.

Figure 10 presents the predicted incremental PM_{10} concentrations from power station operations at the sensitive receptors during 2010. **Figure 11** presents the predicted incremental $PM_{2.5}$ concentrations from power station operations at the sensitive receptors during 2010.

Figure 10 shows that over the modelling year 2010, the maximum predicted 24-hour average PM_{10} concentration due to the power station emissions was $4.0 \mu\text{g}/\text{m}^3$ on 9 August 2010 at Receptor R5.

Figure 10 Predicted Power Station Related PM_{10} Concentrations at Receptors - 2010

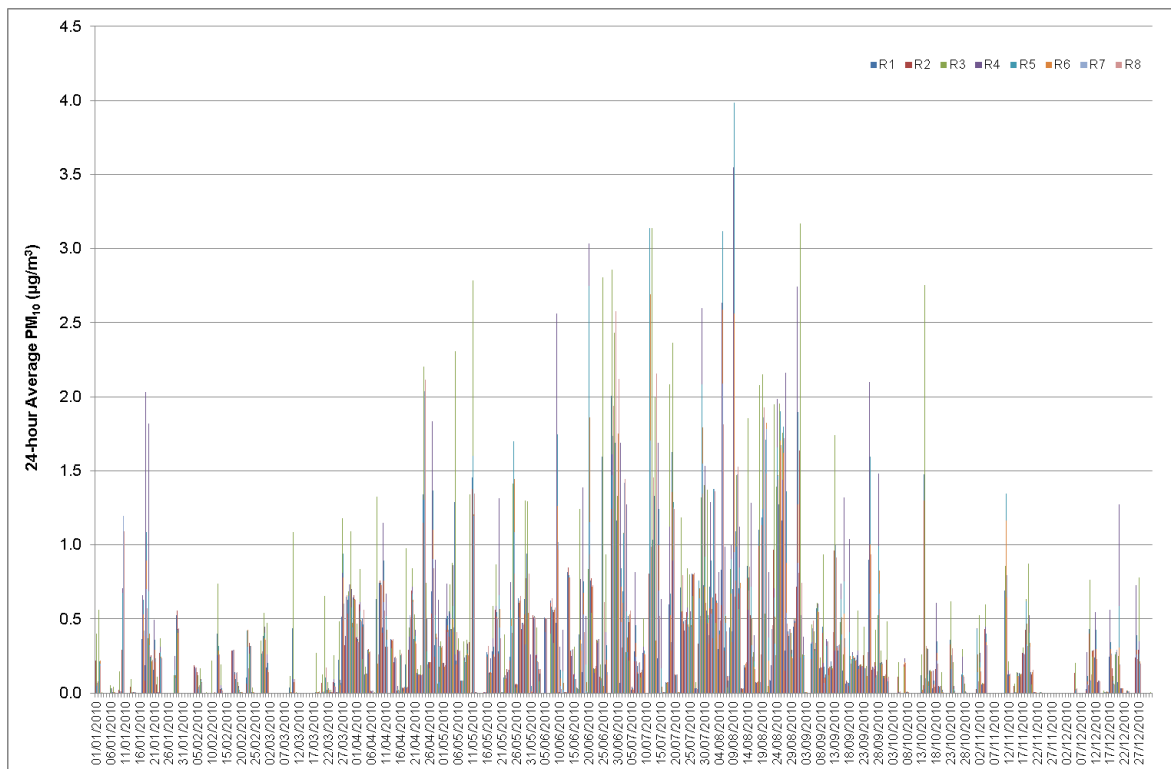
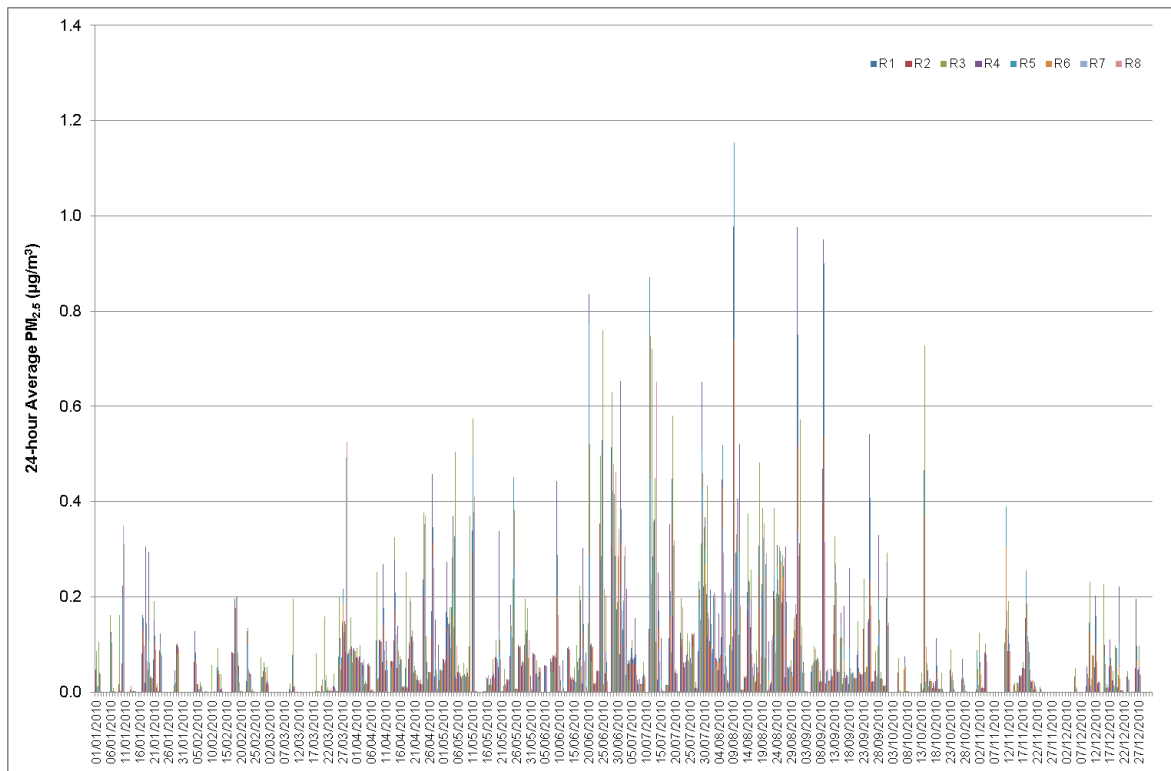


Figure 11 shows that during the year 2010, the maximum predicted 24-hour average $PM_{2.5}$ concentration due to the power station emissions was approximately $1.2 \mu\text{g}/\text{m}^3$ on 9 August 2010 at Receptor R5.

Figure 11 Predicted Power Station Related PM_{2.5} Concentrations at Receptors - 2010



For each receptor location, daily-varying background PM₁₀ and PM_{2.5} concentration files have been constructed, using the regional background particulate data from Wallsend, added to the predicted incremental particulate concentrations from modelling of the power stations.

Presented in **Figure 12** and **Figure 13** are the time series of background PM₁₀ and PM_{2.5} concentrations for Receptor R5 respectively.

Figure 12 Regional Background and Power Station Increment at Receptor R5 (PM₁₀)

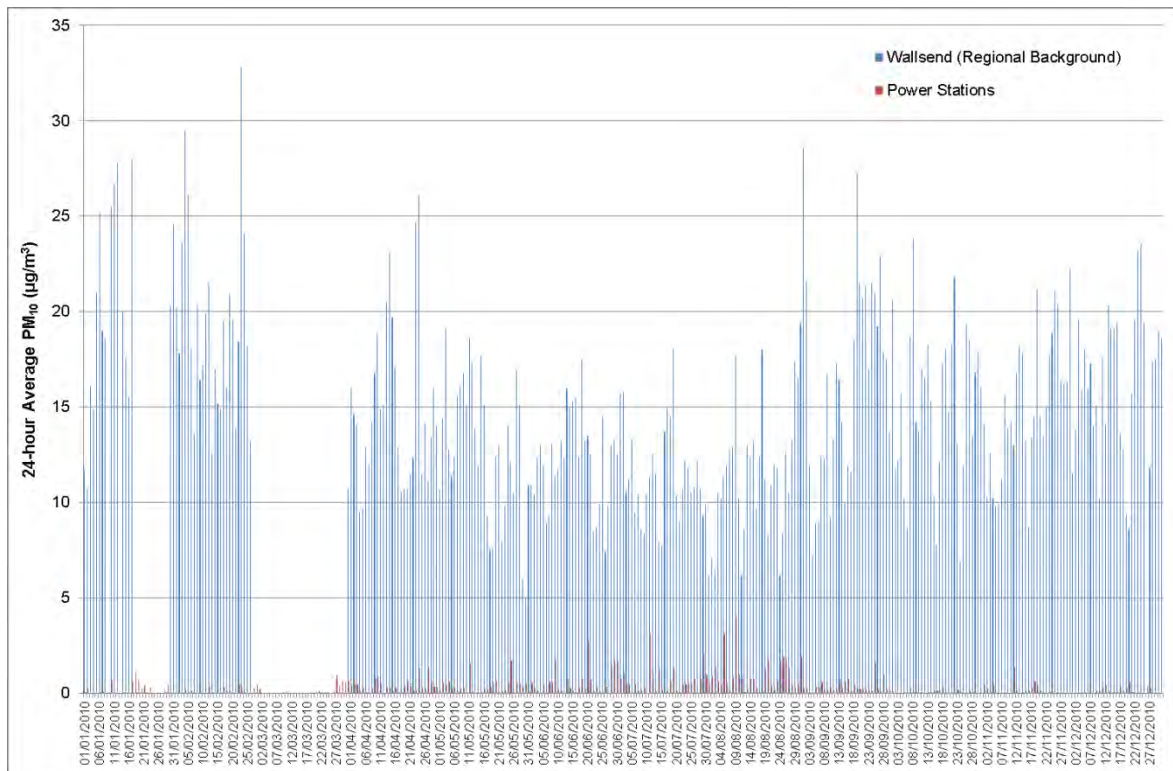
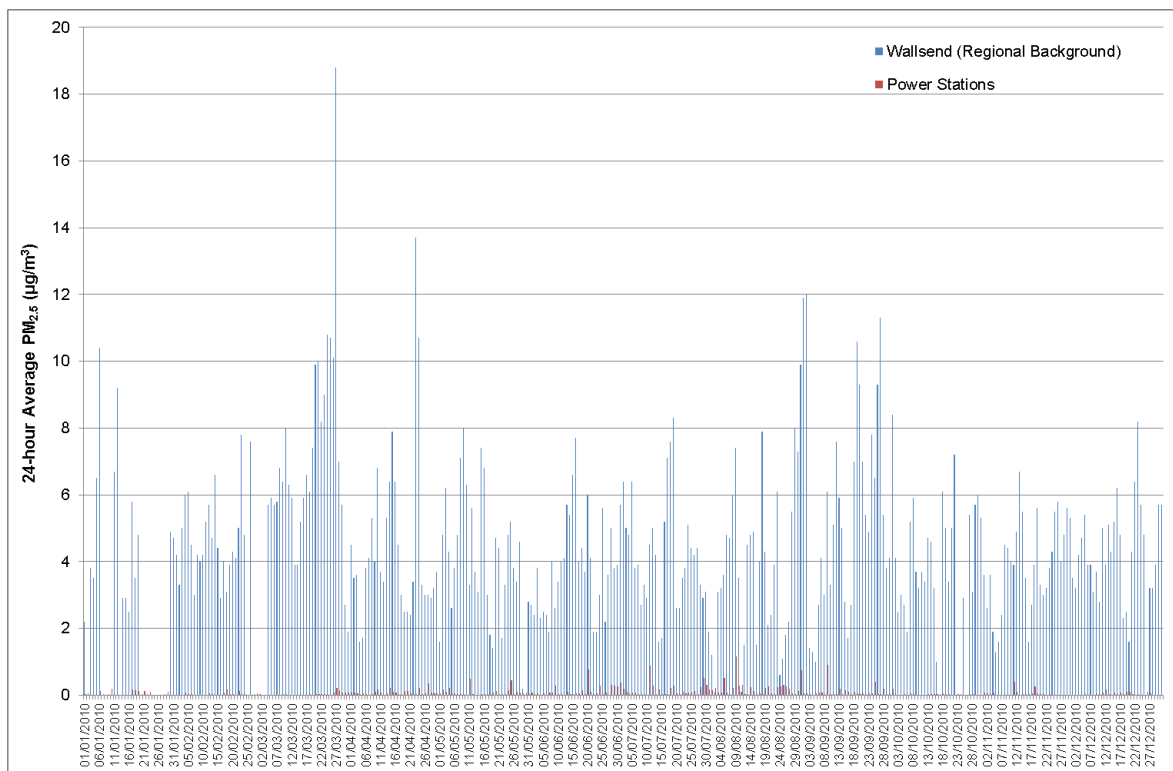


Figure 13 Regional Background and Power Station Increment at Receptor R5 (PM_{2.5})



The derived background concentration files (regional plus power station) vary spatially across the modelling domain based on the results of the power station emission modelling results.

For the assessment of cumulative TSP concentrations, the annual average predictions given by the power station modelling study were added to an estimated annual average regional background value of $29.4 \mu\text{g}/\text{m}^3$. This regional value was derived from the annual average PM_{10} concentration measured at Wallsend AQMS in 2010 multiplied by a factor of two, based on information reported by US EPA (US EPA, 2001) that in non-urban areas without significant impacts from vehicle emissions, $\text{PM}_{10}/\text{TSP}$ ratios are generally in the order of 50% (see **Section 7.1.2**).

7.3 Surrounding Mining Industries

A few surrounding industries have been identified in the region, which are anticipated to have a cumulative impact on the identified sensitive receptors. This section identifies those industries and assesses the possibility of them having a cumulative impact on the sensitive receptors. A summary of the industries considered in this regards is shown in **Table 26**.

Table 26 A Summary of the Mining Industries in the Region

Industry	Location	Section
Awaba Colliery Surface Site (part of the Northern Coal Logistics Project)	~ 5.5 km north-northwest of Myuna	Section 7.3.1
Newstan Colliery Surface Site (part of the Northern Coal Logistics Project)	~ 10 km north of Myuna	
Cooranbong Entry Site (part of the Northern Coal Logistics Project)	~6 km west of Myuna	
Hawkmount Quarry (part of the Northern Coal Logistics Project)	~ 5 km northwest of Myuna	

Note: Eraring, Vales Point and Munmorah Power Stations assessed in **Section 7.2**

7.3.1 Northern Coal Logistics Project

The Northern Coal Logistics Project is part of a long term strategy developed by Centennial for its future operations in the Newcastle Coalfield to provide the infrastructure and flexibility required to meet future opportunities in both the domestic and export coal markets.

The Northern Coal Logistics Project comprises both a continuation of existing operations and an upgrade to the surface coal handling and processing infrastructure at the Newstan Colliery Surface Site and Cooranbong Entry Site, along with the existing private haul roads and rail loading infrastructure.

The Northern Coal Logistics Project comprises (refer also **Figure 14**):

Newstan Colliery Surface Site - Newstan Colliery Surface Site comprises coal handling and processing infrastructure, the Southern Reject Emplacement Area, Northern Reject Emplacement Area, water management infrastructure and rail loading infrastructure. The Project proposes to extend and redevelop the Newstan Colliery Surface Site to accommodate new coal handling and processing infrastructure.

Cooranbong Entry Site - Cooranbong Entry Site comprises a coal handling plant, coal stockpiles, workshop building and water management infrastructure.

Private Haul Roads - The Cooranbong Private Haul Road owned by Centennial Mandalong links the Newstan Colliery Surface Site and the Cooranbong Entry Site via the Newstan-Eraring Private Haul Road. The Newstan-Eraring Private Haul Road links the Newstan Colliery Surface Site to the Eraring Power Station and is owned by Eraring Energy. The Awaba Private Haul Road links the Awaba Colliery Surface Site to the Newstan-Eraring Private Haul Road and is owned by Centennial Newstan Pty Limited.

Hawkmount Quarry – Hawkmount Quarry is an abandoned gravel quarry (Crown land under permissive occupancy held by Lake Macquarie City Council). Hawkmount Quarry has not been used for extraction purposes for several years but is proposed to be used as coarse rejects emplacement area for the Northern Coal Logistics Project.

As part of the Northern Coal Logistics Project, Centennial are seeking to continue to transport up to 0.88 Mtpa of material (including coal and stone from construction activities undertaken as part of the Newstan Colliery Extension of Mining Project) by truck via private haul roads from the Awaba Colliery Surface Site to the reject emplacement areas at the Newstan Colliery Surface Site.

Inset A - Newstan Colliery Surface Site - Proposed disturbance area

Inset B - Hawkmount Quarry - Proposed disturbance area

LEGEND

- Project Application Area
- Private haul road
- Proposed disturbance areas
- Cooranbong Entry Site
- Newstan Colliery Surface Site
- Hawkmount Quarry

Data Source: Aerial photo supplied by Centennial March 2012

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Of the two scenarios which examined impacts due to operations at the Cooranbong Entry Site, the scenario which reflected the transport of up to 6 Mtpa of coal to the Newstan Colliery Surface Site by trucks (rather than 6 Mtpa of coal to Eraring Power Station by overland conveyor) indicated the greatest impacts on surrounding receptors.

Examination of contour plots of incremental increases in particulate resulting from the operation of these two scenarios in conjunction indicates the following (at a location most representative of receptor R4 (119 Donnelly Road, Arcadia Vale, refer **Table 3**). Impacts at all other receptors assessed as part of this study can be considered to be lower than those presented below:

- Increases in annual average dust deposition were predicted to be less than 0.1 g/m²/month.
- Increases in maximum 24-hour PM₁₀ concentrations were predicted to be approximately 1 µg/m³.
- Increases in annual average PM₁₀ concentrations were predicted to be significantly less than 1 µg/m³.
- Increases in maximum 24-hour PM_{2.5} concentrations were predicted to be significantly less than 1 µg/m³.
- Increases in annual average PM₁₀ concentrations were predicted to be significantly less than 1 µg/m³.
- Increases in annual average TSP concentrations were predicted to be approximately 1 µg/m³.

7.4 Background Air Quality for Assessment Purposes

For the purposes of assessing the potential air quality impacts from the Myuna Colliery (at 2 Mtpa and 3 Mtpa production rate), an estimation of ambient air quality concentrations is required. The site-specific ambient air quality concentrations adopted for this assessment are summarised in **Table 27**.

Table 27 Ambient Air Quality Environment for Assessment Purposes

Air Quality Parameter	Averaging Period	Assumed Background Ambient Level	Notes
TSP	Annual	29.4 µg/m ³ PLUS Power Station Increments	Maximum Increment due to Power Station is 8 µg/m ³ at Receptor R5
PM ₁₀	24-hour	Varying	Maximum Increment due to Power Station is 4 µg/m ³ at Receptor R5
	Annual	14.7 µg/m ³ PLUS Power Station Increments	
PM _{2.5}	24-hour	Varying	Maximum Increment due to Power Station is 1.2 µg/m ³ at Receptor R5
	Annual	4.6 µg/m ³ PLUS Power Station Increments	
Deposited Dust	Annual	2 g/m ² /month	Assumed
Odour	1-hour	0 OU	Assumed

8 AIR QUALITY IMPACT ASSESSMENT RESULTS

The following Sections detail the dispersion modelling results for dust deposition (**Section 8.1**), TSP (**Section 8.2**), PM₁₀ (**Section 8.3**), PM_{2.5} (**Section 8.4**) and odour (**Section 8.5**).

Results are presented for the increment due to Project operations plus the derived background particulate concentration as calculated and discussed in **Section 7.4**.

A discussion of the potential cumulative impacts due to other operations is also provided.

8.1 Dust Deposition

Model predictions of the annual average dust deposition rate experienced at all receptors presented in **Table 3** during currently approved (2 Mtpa) and proposed (3 Mtpa) mining activities are presented in **Table 28**. The background deposition rate of 2 g/m²/month has been included to determine the cumulative deposition rate associated with all existing operations in the area and the predicted impact from power stations has also been included as described in **Section 7.2**.

Where impacts are predicted to be <0.1 g/m²/month, these are taken to be 0.1 g/m²/month when assessing the potential cumulative impacts.

Table 28 Predicted Annual Average Dust Deposition (g/m²/month)

Receptor	Currently Approved (2 Mtpa)				Proposed (3 Mtpa)			
	B/G	Inc	PS	Cumu	B/G	Inc	PS	Cumu
R1	2.0	<0.1	<0.1	2.2	2.0	<0.1	<0.1	2.2
R2	2.0	<0.1	<0.1	2.2	2.0	<0.1	<0.1	2.2
R3	2.0	<0.1	<0.1	2.2	2.0	<0.1	<0.1	2.2
R4	2.0	0.1	<0.1	2.2	2.0	0.1	<0.1	2.2
R5	2.0	0.1	<0.1	2.2	2.0	0.1	<0.1	2.2
R6	2.0	0.1	<0.1	2.2	2.0	0.1	<0.1	2.2
R7	2.0	<0.1	0.1	2.2	2.0	<0.1	0.1	2.2
R8	2.0	<0.1	<0.1	2.2	2.0	<0.1	<0.1	2.2
Criterion	-	2.0		4.0	-	2.0		4.0

Note: B/G = Background, Inc = modelled increment from the Project, PS = modelled increment from Power Stations, Cumu = cumulative impact

Contour plots of the incremental (Project only) dust deposition rates predicted are presented as pollutant isopleth plots in **Appendix A**.

Incremental dust deposition rates under both the currently approved and proposed scenarios are predicted to be well below the criterion of 2 g/m²/month at all modelled receptors. With the addition of a background dust deposition rate which takes into account all existing operations in the area, the criterion is also easily achieved at all modelled receptors. Inclusion of the minor increment due to the Northern Coal Logistics Project (approximately 0.1 g/m²/month) results in negligible increases to the dust deposition rate and no changes to the predicted compliance of the Project.

The incremental contribution to the dust deposition rate in the local area is predicted to be small (<0.2 g/m²/month) in both scenarios assessed. Increasing production rate from 2 Mtpa to 3 Mtpa is shown through dispersion modelling to not result in any detrimental impacts upon surrounding receptors.

8.2 Particles (as TSP)

Model predictions of the annual average TSP concentration experienced at all receptors presented in **Table 3** during currently approved (2 Mtpa) and proposed (3 Mtpa) mining activities are presented in **Table 29**. The background TSP concentration of $29.5 \mu\text{g}/\text{m}^3$ has been included to determine the cumulative TSP concentration associated with all existing operations in the area and the predicted impact from power stations has also been included as described in **Section 7.2**.

Where impacts are predicted to be $<0.1 \mu\text{g}/\text{m}^3$, these are taken to be $0.1 \mu\text{g}/\text{m}^3$ when assessing the potential cumulative impacts.

Table 29 Predicted Annual Average TSP Concentration ($\mu\text{g}/\text{m}^3$)

Receptor	Currently Approved (2 Mtpa)				Proposed (3 Mtpa)			
	B/G	Inc	PS	Cumu	B/G	Inc	PS	Cumu
R1	29.5	0.6	<0.1	30.2	29.5	0.7	<0.1	30.3
R2	29.5	0.4	<0.1	30.0	29.5	0.5	<0.1	30.1
R3	29.5	1.1	<0.1	30.7	29.5	1.4	<0.1	31.0
R4	29.5	1.0	<0.1	30.6	29.5	1.1	<0.1	30.7
R5	29.5	1.3	0.1	30.9	29.5	1.6	0.1	31.1
R6	29.5	1.7	0.2	31.4	29.5	1.8	0.2	31.5
R7	29.5	0.8	0.5	30.7	29.5	0.9	0.5	30.9
R8	29.5	0.7	0.1	30.2	29.5	0.8	0.1	30.3
Criterion	-	-	-	90	-	-	-	90

Note: B/G = Background, Inc = modelled increment from the Project, PS = modelled increment from Power Stations, Cumu = cumulative impact

Contour plots of the incremental (Project only) TSP concentrations predicted are presented as pollutant isopleth plots in **Appendix A**.

Cumulative annual average TSP concentrations under both the currently approved and proposed scenarios are predicted to be well below the criterion of $90 \mu\text{g}/\text{m}^3$ at all modelled receptors even with the inclusion of a predicted annual average TSP concentration of $1 \mu\text{g}/\text{m}^3$ to account for the Northern Coal Logistics Project.

Increasing production rate from 2 Mtpa to 3 Mtpa is shown through dispersion modelling to not result in any detrimental impacts upon surrounding receptors.

8.3 Particles (as PM₁₀)

8.3.1 Annual Average

Model predictions of the annual average PM₁₀ concentration experienced at all receptors presented in **Table 3** during currently approved (2 Mtpa) and proposed (3 Mtpa) mining activities are presented in **Table 30**. The background PM₁₀ concentration of 14.7 µg/m³ has been included to determine the cumulative PM₁₀ concentration associated with all existing operations in the area and the predicted impact from power stations has also been included as described in **Section 7.2**.

Where impacts are predicted to be <0.1 µg/m³, these are taken to be 0.1 µg/m³ when assessing the potential cumulative impacts.

Table 30 Predicted Annual Average PM₁₀ Concentration (µg/m³)

Receptor	Currently Approved (2 Mtpa)				Proposed (3 Mtpa)			
	B/G	Inc	PS	Cumu	B/G	Inc	PS	Cumu
R1	14.7	0.2	<0.1	15.0	14.7	0.2	<0.1	15.0
R2	14.7	0.1	<0.1	14.9	14.7	0.1	<0.1	14.9
R3	14.7	0.4	<0.1	15.2	14.7	0.4	<0.1	15.2
R4	14.7	0.2	<0.1	15.0	14.7	0.2	<0.1	15.0
R5	14.7	0.3	0.1	15.1	14.7	0.3	0.1	15.1
R6	14.7	0.4	0.1	15.2	14.7	0.4	0.1	15.2
R7	14.7	0.2	0.3	15.2	14.7	0.2	0.3	15.2
R8	14.7	0.2	0.0	14.9	14.7	0.2	0.0	14.9
Criterion	-	-	-	30	-	-	-	30

Note: B/G = Background, Inc = modelled increment from the Project, PS = modelled increment from Power Stations, Cumu = cumulative impact

Contour plots of the incremental (Project only) annual average PM₁₀ concentrations predicted are presented as pollutant isopleth plots in **Appendix A**. Cumulative annual average PM₁₀ concentrations under both the currently approved and proposed scenarios are predicted to be well below the NSW EPA criterion of 30 µg/m³ and the WHO criterion of 20 µg/m³ at all modelled receptors even taking into account the negligible impact (<1 µg/m³) from the Northern Coal Logistics Project. Increasing production rate from 2 Mtpa to 3 Mtpa is shown through dispersion modelling to not result in any detrimental impacts upon surrounding receptors.

8.3.2 Maximum 24-hour Average

Model predictions of the maximum 24-hour average PM₁₀ concentration experienced at all receptors presented in **Table 3** during currently approved (2 Mtpa) and proposed (3 Mtpa) mining activities are presented in **Table 31** and **Table 32** respectively.

Please note that further description and clarification of the data presented in the results tables is included in **Appendix B**.

The background PM₁₀ concentration varies by day and therefore the tables include an assessment of the following:

- The maximum cumulative 24-hour average PM₁₀ concentration to enable assessment of compliance against the EPA criterion of 50 µg/m³; and
- The cumulative 24-hour average PM₁₀ concentration during the day when the maximum increment is experienced from the Project operation.

The background PM₁₀ data has been generated as discussed in detail in **Section 7**. This has been generated to include all existing operations in the area.

It is shown that the maximum cumulative concentrations under both Scenarios are dominated by background PM₁₀ concentrations. Maximum increments due to the Project are shown to be up to 19 µg/m³. With the inclusion of an additional approximately 1 µg/m³ resulting from the Northern Coal Logistics Project, the Project is not predicted to result in any exceedances of the 50 µg/m³ criterion, nor the proposed 40 µg/m³ criterion.

Where impacts are predicted to be <0.1 µg/m³, these are taken to be 0.1 µg/m³ when assessing the potential cumulative impacts.

Table 31 Predicted Maximum 24-hour Average PM₁₀ Concentration (µg/m³) – 2 Mtpa

Receptor	Assessment of Maximum Cumulative Impact					Assessment of Maximum Incremental Impact				
	Date	B/G	Inc.	PS	Maximum Cumu.	Date	B/G	Maximum Inc.	PS	Cumu.
R1	01-09-2010	28.6	3.0	1.5	33.2	24-06-2010	9.9	8.5	0.1	18.5
R2	23-02-2010	32.8	<0.1	0.3	33.2	24-06-2010	9.9	7.7	0.1	17.7
R3	23-02-2010	32.8	<0.1	0.3	33.2	23-11-2010	17.7	14.0	<0.1	31.8
R4	23-02-2010	32.8	1.7	0.3	34.8	10-08-2010	10.2	7.7	0.6	18.4
R5	23-02-2010	32.8	1.9	0.3	35.0	05-07-2010	13.3	18.8	<0.1	32.2
R6	23-02-2010	32.8	0.4	0.3	33.5	05-07-2010	13.3	8.8	<0.1	22.2
R7	23-02-2010	32.8	0.1	0.3	33.2	01-07-2010	15.7	6.5	0.5	22.7
R8	23-02-2010	32.8	<0.1	0.3	33.2	09-09-2010	16.7	7.5	0.1	24.3
Criterion					50.0					50.0

Note: B/G = Background, Inc = modelled increment from the Project, Cumu = cumulative impact

Table 32 Predicted Maximum 24-hour Average PM₁₀ Concentration (µg/m³) – 3 Mtpa

Receptor	Assessment of Maximum Cumulative Impact					Assessment of Maximum Incremental Impact				
	Date	B/G	Inc.	PS	Maximum Cumu.	Date	B/G	Maximum Inc.	PS	Cumu.
R1	01/09/2010	28.6	3.6	1.5	33.8	24/06/2010	9.9	8.7	0.1	18.8
R2	23/02/2010	32.8	<0.1	0.3	33.2	24/06/2010	9.9	8.7	0.1	18.7
R3	06/01/2010	25.2	8.3	0.1	33.6	21/11/2010	13.5	15.9	<0.1	29.5
R4	23/02/2010	32.8	1.9	0.3	35.0	10/08/2010	10.2	8.4	0.6	19.2
R5	23/02/2010	32.8	1.9	0.3	35.1	05/07/2010	13.3	20.0	<0.1	33.4
R6	23/02/2010	32.8	0.5	0.3	33.6	05/07/2010	13.3	9.9	<0.1	23.3
R7	23/02/2010	32.8	0.1	0.3	33.2	01/07/2010	15.7	7.2	0.5	23.3
R8	23/02/2010	32.8	<0.1	0.3	33.2	09/09/2010	16.7	7.8	0.1	24.6
Criterion					50.0					50.0

Note: B/G = Background, Inc = modelled increment from the Project, Cumu = cumulative impact

Increasing production rate from 2 Mtpa to 3 Mtpa is shown through dispersion modelling to not result in any detrimental impacts upon surrounding receptors. Maximum 24-hour PM₁₀ concentrations are dominated by activities at the emergency coal stockpile which have been modelled to occur on every day of the year to assess maximum potential impacts. Under some years, these operations may not occur, and the concentrations of PM₁₀ may be significantly lower than those modelled.

8.4 Particles (as PM_{2.5})

Annual Average

Model predictions of the annual average PM_{2.5} concentration experienced at all receptors presented in **Table 3** during currently approved (2 Mtpa) and proposed (3 Mtpa) mining activities are presented in **Table 33**. The background PM_{2.5} concentration of 4.6 µg/m³ has been included to determine the cumulative PM_{2.5} concentration associated with all existing operations in the area and the predicted impact from power stations has also been included as described in **Section 7.2**.

Where impacts are predicted to be <0.1 µg/m³, these are taken to be 0.1 µg/m³ when assessing the potential cumulative impacts.

Table 33 Predicted Annual Average PM_{2.5} Concentration (µg/m³)

Receptor	Currently Approved (2 Mtpa)				Proposed (3 Mtpa)			
	B/G	Inc	PS	Cumu	B/G	Inc	PS	Cumu
R1	4.6	0.1	<0.1	4.8	4.6	0.1	<0.1	4.8
R2	4.6	<0.1	<0.1	4.8	4.6	0.1	<0.1	4.8
R3	4.6	0.1	<0.1	4.8	4.6	0.1	<0.1	4.8
R4	4.6	0.1	<0.1	4.8	4.6	0.2	<0.1	4.9
R5	4.6	0.2	<0.1	4.9	4.6	0.2	<0.1	4.9
R6	4.6	0.3	<0.1	5.0	4.6	0.3	<0.1	5.0
R7	4.6	0.1	<0.1	4.8	4.6	0.1	<0.1	4.8
R8	4.6	0.1	<0.1	4.8	4.6	0.1	<0.1	4.8
Criterion	-	-	-	8	-	-	-	8

Note: B/G = Background, Inc = modelled increment from the Project, PS = modelled increment from Power Stations, Cumu = cumulative impact

Contour plots of the incremental (Project only) annual average PM_{2.5} concentrations predicted are presented as pollutant isopleth plots in **Appendix A**. Cumulative annual average PM_{2.5} concentrations under both the currently approved and proposed scenarios are predicted to be well below the advisory reporting standard of 8 µg/m³. Increasing production rate from 2 Mtpa to 3 Mtpa is shown through dispersion modelling to not result in any detrimental impacts upon surrounding receptors.

Maximum 24-hour Average

Model predictions of the maximum 24-hour average PM_{2.5} concentration experienced at all receptors presented in **Table 3** during currently approved (2 Mtpa) and proposed (3 Mtpa) mining activities are presented in **Table 34** and **Table 35** respectively.

Please note that further description and clarification of the data presented in the results tables is included in **Appendix B**.

The background PM_{2.5} concentration varies by day and therefore the tables include an assessment of the following:

- The maximum cumulative 24-hour average PM_{2.5} concentration to enable assessment of compliance against the advisory standard of 25 µg/m³; and
- The cumulative 24-hour average PM_{2.5} concentration during the day when the maximum increment is experienced from the Project operation.

The background PM_{2.5} data has been generated as discussed in detail in **Section 7**. This has been generated to include all existing operations in the area.

It is shown that the maximum cumulative concentrations under both Scenarios are dominated by background PM_{2.5} concentrations. Maximum increments due to the Project are shown to be up to 3 µg/m³. With the inclusion of an additional <1 µg/m³ resulting from the Northern Coal Logistics Project, concentrations of 24-hour maximum PM_{2.5} are not predicted to be in exceedance of the 25 µg/m³ advisory (and recommended to be adopted) standard at any receptor locations under any scenario assessed.

Where impacts are predicted to be <0.1 µg/m³, these are taken to be 0.1 µg/m³ when assessing the potential cumulative impacts.

Table 34 Predicted Maximum 24-hour Average PM_{2.5} Concentration (µg/m³) – 2 Mtpa

Receptor	Assessment of Maximum Cumulative Impact					Assessment of Maximum Incremental Impact				
	Date	B/G	Inc.	PS	Maximum Cumu.	Date	B/G	Maximum Inc.	PS	Cumu.
R1	27-03-2010	18.8	<0.1	0.1	19.0	29-05-2010	0.2	1.8	0.1	2.1
R2	27-03-2010	18.8	<0.1	0.1	19.0	24-06-2010	3.0	1.1	0.4	4.5
R3	27-03-2010	18.8	0.3	0.1	19.2	25-12-2010	4.8	2.6	<0.1	7.5
R4	27-03-2010	18.8	0.9	0.1	19.8	24-07-2010	5.1	1.8	0.1	7.0
R5	27-03-2010	18.8	0.9	0.2	19.9	05-07-2010	6.4	2.6	0.1	9.1
R6	27-03-2010	18.8	0.1	0.2	19.1	06-06-2010	2.4	2.2	<0.1	4.7
R7	27-03-2010	18.8	0.1	0.1	19.0	20-05-2010	4.7	1.4	0.1	6.2
R8	27-03-2010	18.8	0.1	0.1	19.0	31-05-2010	2.8	1.7	<0.1	4.6
Criterion	25.0					25.0				

Note: B/G = Background, Inc = modelled increment from the Project, Cumu = cumulative impact

Table 35 Predicted Maximum 24-hour Average PM_{2.5} Concentration (µg/m³) – 3 Mtpa

Receptor	Assessment of Maximum Cumulative Impact					Assessment of Maximum Incremental Impact				
	Date	B/G	Inc.	PS	Maximum Cumu.	Date	B/G	Maximum Inc.	PS	Cumu.
R1	27-03-2010	18.8	<0.1	0.1	19.0	29-05-2010	0.2	1.8	0.1	2.1
R2	27-03-2010	18.8	<0.1	0.1	19.0	24-06-2010	3.0	1.3	0.4	4.7
R3	27-03-2010	18.8	0.4	0.1	19.3	25-12-2010	4.8	2.9	<0.1	7.8
R4	27-03-2010	18.8	1.0	0.1	19.9	24-07-2010	5.1	1.9	0.1	7.1
R5	27-03-2010	18.8	0.9	0.2	19.9	05-07-2010	6.4	2.8	0.1	9.3
R6	27-03-2010	18.8	0.1	0.2	19.1	06-06-2010	2.4	2.3	<0.1	4.8
R7	27-03-2010	18.8	0.1	0.1	19.0	20-05-2010	4.7	1.5	0.1	6.3
R8	27-03-2010	18.8	0.1	0.1	19.0	31-05-2010	2.8	1.7	<0.1	4.6
Criterion	25.0					25.0				

Note: B/G = Background, Inc = modelled increment from the Project, Cumu = cumulative impact

Increasing production rate from 2 Mtpa to 3 Mtpa is shown through dispersion modelling to not result in any detrimental impacts upon surrounding receptors. Maximum 24-hour PM_{2.5} concentrations are dominated by activities at the emergency coal stockpile which have been modelled to occur on every day of the year to assess maximum potential impacts. Under some years, these operations may not occur, and the concentrations of PM_{2.5} may be significantly lower than those modelled.

8.5 Odour

Table 36 presents the 99th percentile 1-hour average odour concentrations predicted by the dispersion modelling at each of the nominated residences/properties using the odour emission rates listed in **Section 5.3**. It is noted that the background odour concentration is assumed to be zero.

Contour plots of the predicted odour concentrations are presented in **Appendix A**.

Table 36 99th percentile 1-hour Average Odour Concentrations

Receptor ID	Increment (OU)
R1	1.2
R2	0.6
R3	0.9
R4	1.4
R5	1.5
R6	1.9
R7	1.2
R8	1.1

Note: Project criterion – 2 OU

It is noted that the 99th percentile 1-hour average odour concentration are predicted to be below the Project criterion of 2 OU at all eight sensitive receptors.

8.6 Air Quality Monitoring

Air quality monitoring (1-in-6 day HVAS for PM₁₀ and TSP and dust deposition monitoring) will continue to be performed by Centennial Myuna Colliery to monitor air quality impacts due to the operation of the Myuna Colliery.

The data will be used to inform the efficacy of control measures as outlined in **Section 5.2.1**.

9 CONCLUSION

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by Centennial Myuna Pty Ltd (CMPL) to conduct an Air Quality Impact Assessment (AQIA) for the Myuna Colliery Modification Project (the Project) located within the Northern Coalfield of NSW approximately 90 kilometres (km) northeast of Sydney. Myuna Colliery's Surface Facilities Area is located in Wangi Wangi on the western side of Lake Macquarie, 25 km southwest of Newcastle.

CMPL currently operate under Project Approval (PA) 10_0080 which was granted in January 2012 and allows extraction of up to 2 million tonnes of ROM coal from the site per calendar year. CMPL wishes to modify this PA to allow extraction of up to 3 million tonnes of ROM coal per calendar year.

The assessment of the potential impacts on air quality resulting from Project operation has included an assessment of impacts during both currently approved and proposed mining activities, with emissions of particulate matter (or dust) and odour resulting from each scenario calculated to reflect the possible worst case operation of the Project (i.e. the operation of the emergency coal stockpile).

A dispersion modelling assessment has been performed in which the calculated and controlled emissions were used as input, as was meteorological data which has been shown to represent the area appropriately. In addition, an estimate of the existing air quality (i.e. that without the impact of the Project) was made using data collected in the immediate area and an inclusion of the potential impacts of power station operation has also been included.

An assessment of the impacts of the Northern Coal Logistics Project has also been performed to ensure that the operation of the Project is not limited by operations of this nearby operation.

The findings of the dispersion modelling assessment indicate that (under both the currently approved and proposed Project operation):

- All annual average particulate impacts (dust deposition, PM₁₀, PM_{2.5}, TSP) are in compliance with advisory reporting standards, NSW EPA and WHO criteria at all receptors assessed;
- All annual average criteria remain in compliance with advisory reporting standards, NSW EPA and WHO criteria when taking into account the Northern Coal Logistics Project;
- Maximum 24-hour PM_{2.5} concentrations are predicted to be below the advisory reporting standard at all receptors assessed, including an approximation of background (i.e. existing air quality); and
- Maximum 24-hour PM₁₀ concentrations are predicted to be below the NSW EPA criterion of 50 µg/m³ (and the potential criterion of 40 µg/m³) at all receptors including an approximation of background (i.e. existing air quality).
- Odour concentrations are predicted to be below the NSW EPA criterion of 2 OU at all receptors assessed.

Through this dispersion modelling exercise, it has been shown that the operation of the Project under both the 2 Mtpa and 3 Mtpa production rates will not cause any exceedances of the adopted criteria at any receptor assessed. Additionally, changes in the air quality resulting from the proposed production increase are predicted to be minimal with impacts dominated by operations at the emergency coal stockpiles, at which operations are not proposed to change.

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Appendix A

Report Number 630.10123.05000-R1

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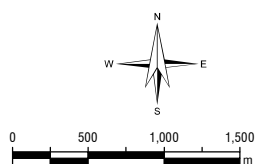
Contour Plots



SLR 

10 KINGS ROAD
NEW LAMBTON
NEW SOUTH WALES 2305
AUSTRALIA
T: 61 2 4037 3200
F: 61 2 4037 3201
www.slrconsulting.com

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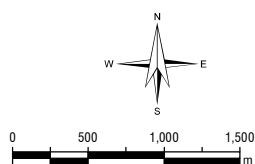




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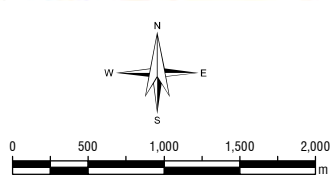




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Centennial Myuna Pty Ltd

Myuna Air Quality Impact Assessment

TSP (Annual)
3Mt per annum



PM10 (Annual)
2Mt per annum



PM10 (Annual)
3Mt per annum





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Centennial Myuna Pty Ltd

Myuna Air Quality Impact Assessment

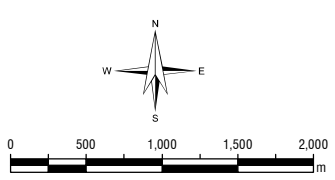
**PM10 (Max 24hr)
3Mt per annum**



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Centennial Myuna Pty Ltd

Myuna Air Quality Impact Assessment

PM2.5 (Annual)
2Mt per annum



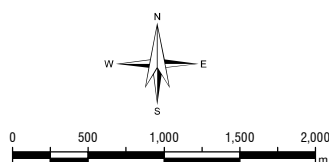
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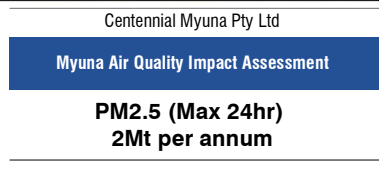
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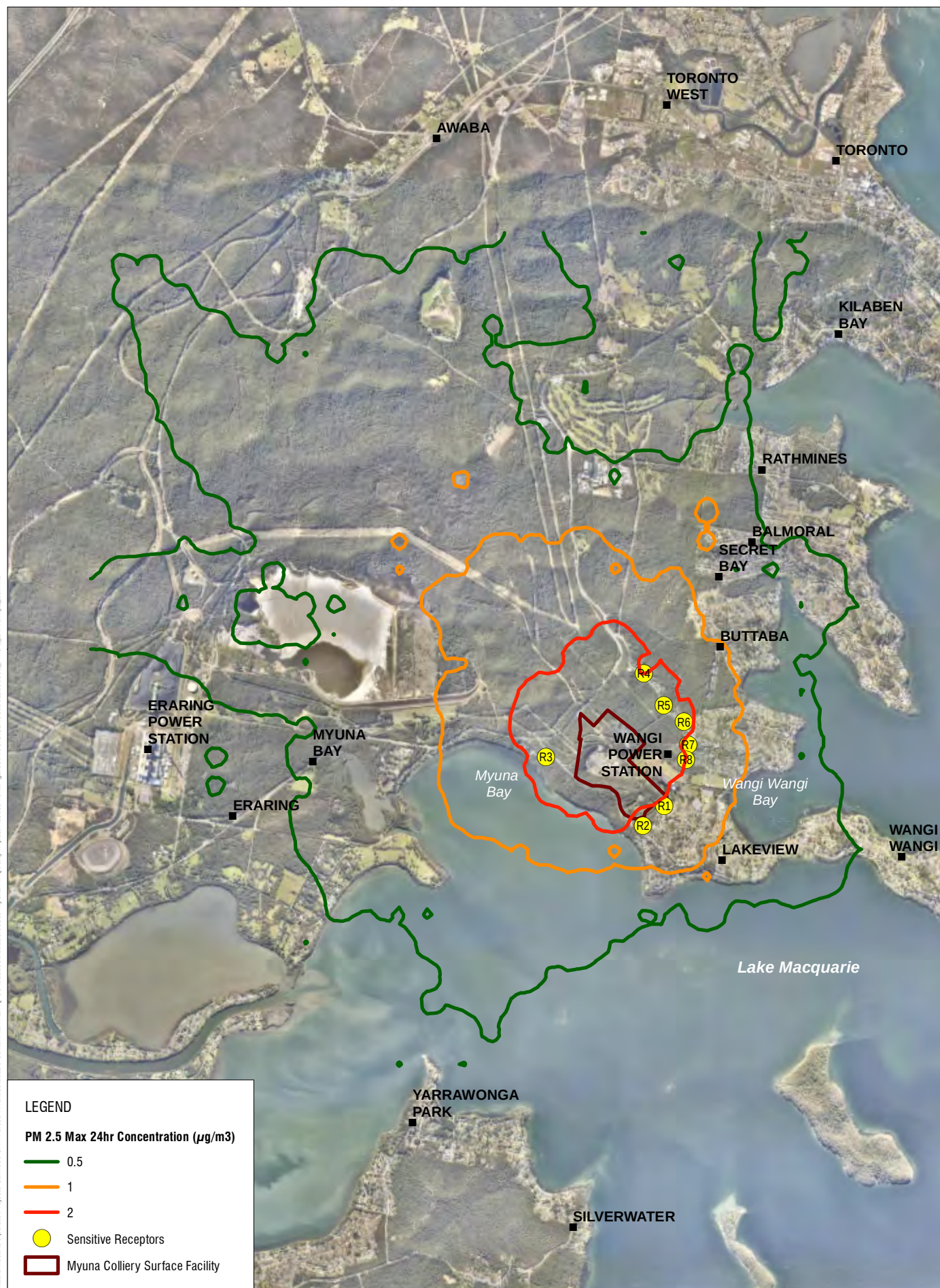
Myuna Air Quality Impact Assessment

PM2.5 (Annual)
3Mt per annum



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Centennial Myuna Pty Ltd

Myuna Air Quality Impact Assessment

PM2.5 (Max 24hr)
3Mt per annum



Description of Results Tables for Maximum 24-hr Particulate Impacts

Maximum Cumulative Impacts

This is an assessment of the day by day variation in background concentration PLUS the day by day variation in the contribution from the Project, added together. The maximum cumulative concentration is used to assess compliance with the relevant 24-hr criterion.

The date on which the maximum cumulative concentration occurs can very often be determined by the date on which the maximum background concentration occurs. In the case of PM₁₀, maximum 24-hour background concentrations occurred on 23 October 2010 (32.8 µg/m³). The increments from the Project on these days are added to determine the maximum cumulative impact.

Receptor	Assessment of Maximum Cumulative Impact				Assessment of Maximum Incremental Impact			
	Date	B/G	Inc.	Maximum Cumu.	Date	B/G	Maximum Inc.	Cumu.

The maximum cumulative impact from the Project PLUS the background concentration. Daily varying background concentration is added to the daily varying contribution from the Project. It can often be driven by large background concentrations

The contribution from the Project on the day of maximum cumulative impact

The background concentration on the day of maximum cumulative impact

The date on which the maximum cumulative impact (background PLUS Project) occurs

Maximum Incremental Impacts

This is an assessment of the maximum predicted impacts due to the Project. It is not an assessment of compliance but provides an indication of the likely maximum impacts due to the Project at each receptor. The corresponding background concentration on the day of maximum Project impact is extracted and reported.

The date on which the maximum incremental concentration occurs varies by receptor, or group of receptors.

Receptor	Assessment of Maximum Cumulative Impact				Assessment of Maximum Incremental Impact			
	Date	B/G	Inc.	Maximum Cumu.	Date	B/G	Maximum Inc.	Cumu.

The date on which the maximum incremental impact (Project impact) occurs

The background concentration on the day of maximum incremental (Project) impact

The maximum predicted contribution from the Project

The cumulative impact related to the maximum Project impact plus the background concentration on that day

Appendix D – Groundwater and Water and Salt Balance Review (GHD 2014)



24 October 2014

James Wearne
Environmental Coordinator
Centennial Coal
PO Box 1000
TORONTO NSW 2283

Our ref: 22/17054
Your ref: 107569

Dear James,

Northern Operations Water and Salt Balance Myuna Modification

1 Introduction

Myuna Colliery is an existing underground coal mine located in Wangi Wangi on the western side of Lake Macquarie in the Newcastle Coalfields, approximately 25 kilometres south of Newcastle. Centennial Myuna Pty Ltd (Centennial Myuna) has owned and operated the mine since 2002. The location of Myuna Colliery is shown in Figure 1.

Continuous miner bord and pillar operations have occurred at Myuna Colliery in the Wallarah, Great Northern and Fassifern seams since 1981. Centennial Myuna was granted approval in January 2012 under Project Approval 10_0080 to extract up to 2 million tonnes per annum (Mtpa) of run of mine (ROM) coal until 31 December 2032 within Consolidated Coal Lease 762 (CCL762) and Mining Lease 1370 (ML1370). Coal from Myuna is taken by dedicated overland coal conveyor to Eraring Power Station.

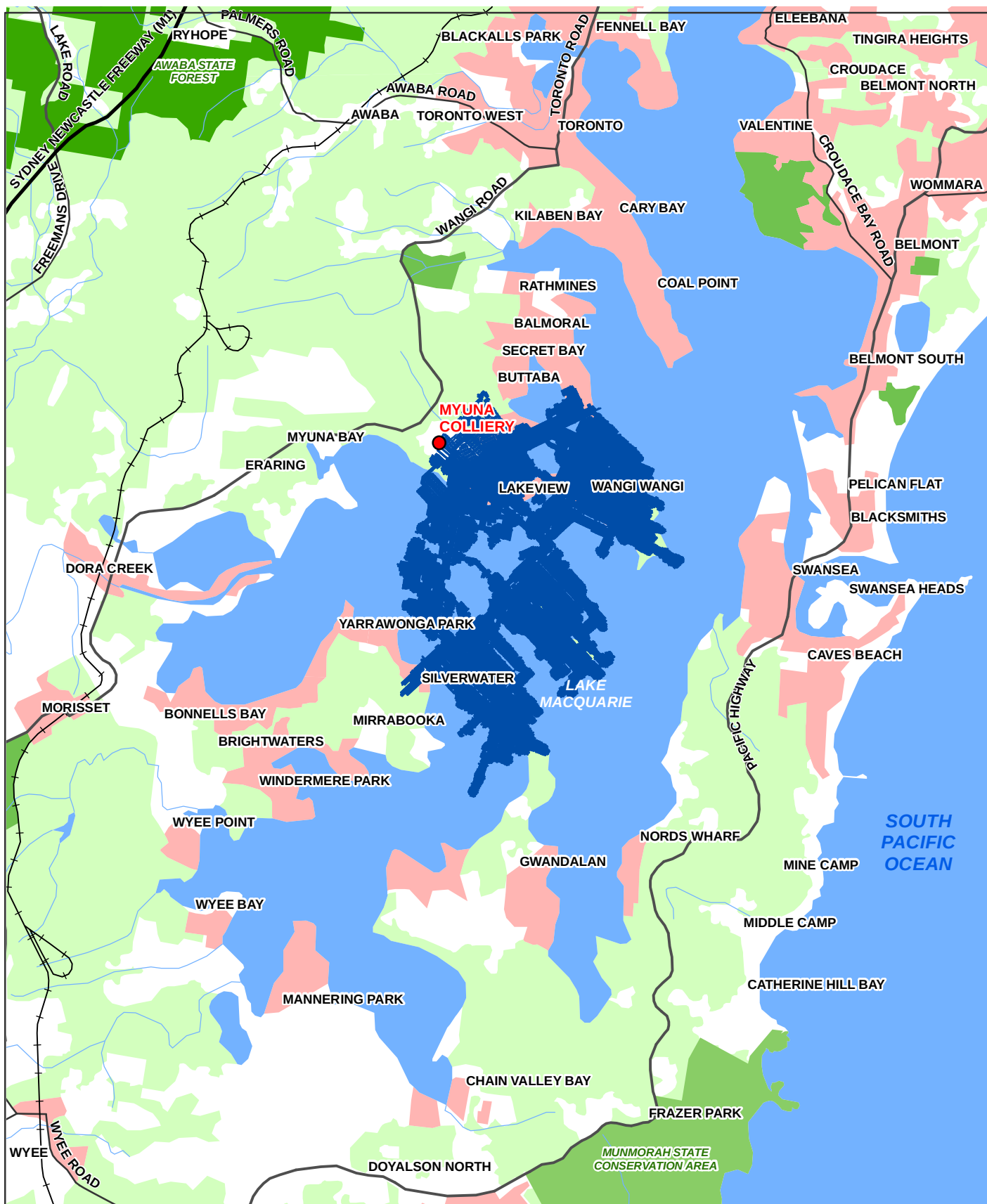
Centennial Myuna is in the process of applying for a Modification to Project Approval 10_0080 to increase the extraction rate to 3 Mtpa of ROM coal within CCL762 and ML1370. This report assesses groundwater extraction and surface water discharge at Myuna Colliery in the context of the regional water and salt balance, utilising the existing Northern Operations Water and Salt Balance (GHD, 2014).

2 Northern Operations Water and Salt Balance – Background Information

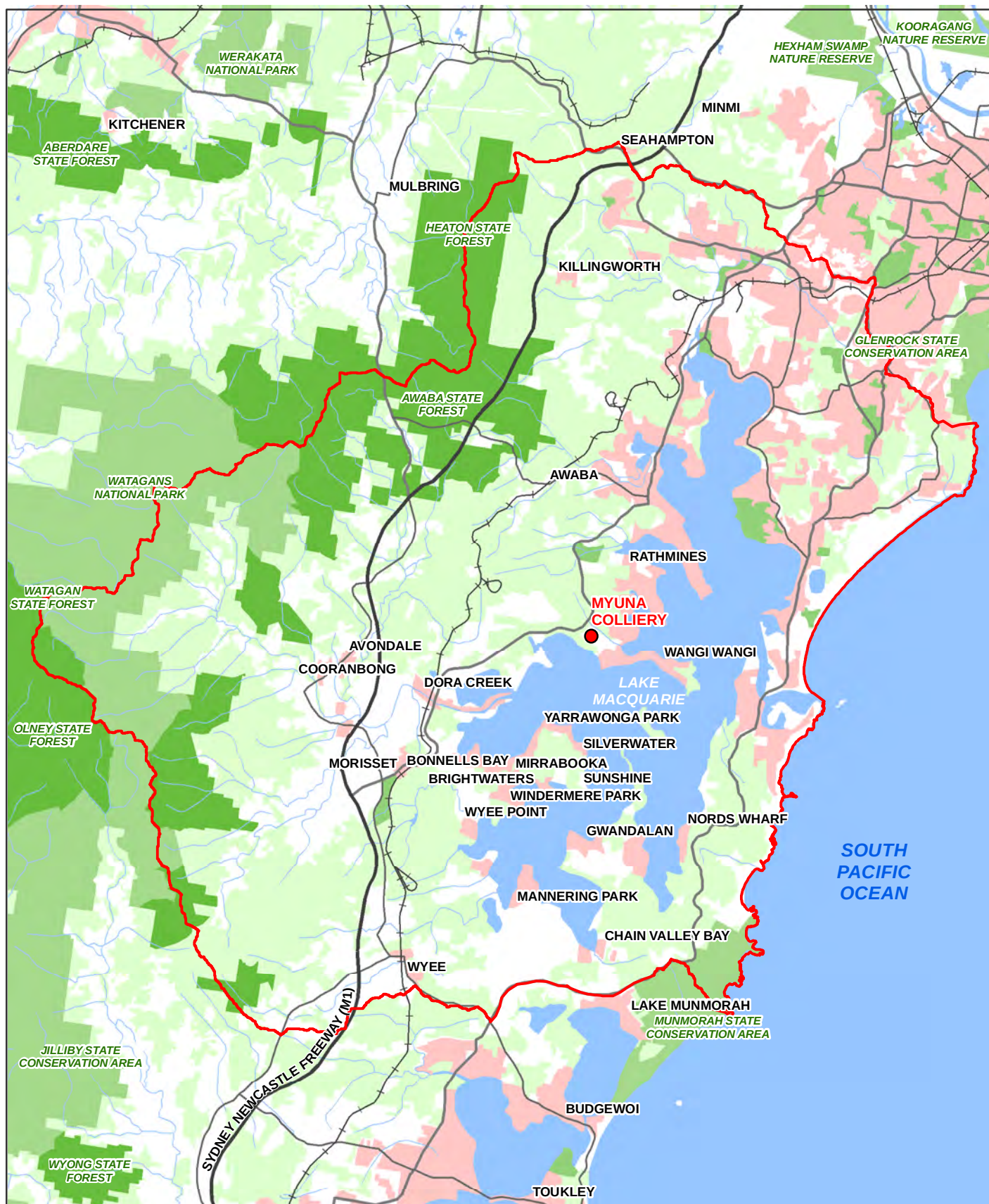
The Northern Operations Water and Salt Balance was developed to assist Centennial Coal to understand the potential cumulative impact of current and future operations on the regional water and salt balance by considering the cumulative water inputs and outputs of both Centennial-owned and non-Centennial operations in the region. GHD Pty Ltd (GHD) was engaged by Centennial Coal to develop this region water and salt balance and identify interactions with relevant surface water and groundwater Water Sharing Plans (WSPs), as well as compare current and future discharges with Centennial's Environment Protection Licence (EPL) limits.

2.1 Study Area

The Study Area for the Northern Operations Water and Salt Balance has been defined by the surface water catchment to Lake Macquarie, which encompasses all Centennial sites in the Newcastle Coalfield and all surface water catchments that Centennial Coal sites potentially interact with. Generally, this area extends from Warners Bay in the north to Wyee in the south and from Toronto in the west to the Tasman Sea in the east. The boundary of the Study Area is presented in Figure 2.



1:100,000 for A4 0 0.3 0.6 1.2 1.8 2.4 Kilometers Map Projection: Universal Transverse Mercator Horizontal Datum: Geodetic Datum of Australia 1994 Grid: Map Grid of Australia, Zone 56		LEGEND - Existing Rail - Watercourse - Freeway - Principal Road - Secondary Road - Watercourse Area - Built Up Areas - Nature Conservation Reserve - State Forest - Forest Or Shrub - Myuna Underground Working	
© 2014. Whilst every care has been taken to prepare this map, GHD and Geoscience Australia make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.		LOCATION Myuna SEAM Great Northern, Fassifern & Wallarah Seam DRAWN S.M CHECKED APPROVED SCALE refer to scalebar	
Northern Operations Water and Salt Balance: Myuna Modification Locality Plan		 Centennial Myuna DATE 14/10/2014 Figure 1	



1:210,000 for A4 0 0.5 1 2 3 4 Kilometers Map Projection: Universal Transverse Mercator Horizontal Datum: Geodetic Datum of Australia 1994 Grid: Map Grid of Australia, Zone 56		LEGEND Study Area Principal Road Existing Rail Watercourse Freeway Nature Conservation Reserve State Forest Forest Or Shrub Watercourse Area Built Up Areas	
© 2014. Whilst every care has been taken to prepare this map, GHD and Geoscience Australia make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.		LOCATION Myuna SEAM Great Northern, Fassifern & Wallarah Seam DRAWN S.M CHECKED APPROVED SCALE refer to scalebar	
Northern Operations Water and Salt Balance: Myuna Modification Water and Salt Balance Study Area		 Centennial Myuna DATE 14/10/2014 Figure 2	

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©Geoscience Australia: 250k Topographic Data, 2006.

2.2 Extent of the Water and Salt Balance

The Northern Operations Water and Salt Balance considers the cumulative impact of coal mining and other operations in the Study Area on licensed water extractions and discharges. The sites assessed are limited to those listed in Table 1, which were determined in consultation with Centennial Coal as the known major water users in the Study Area occurring over the next 36 year period. Other water users in the region have therefore not been considered in this assessment.

Table 1 Sites Incorporated into the Northern Operations Water and Salt Balance Assessment

Site	Owner	Site details	Status
Aquabait	Aquabait Pty Ltd	Marine worm aquaculture operation	Operational
Chain Valley Colliery	LakeCoal Pty Limited	Underground coal mine	Operational
Coal Logistics Project	Northern Coal Services (Centennial)	Coal processing, handling and transport	Project
Eraring Power Station	Eraring Energy	Power station	Operational
Frazer Park Quarry	HB Frazer Park Pty Ltd	Quarry	Operational
Mandalong Mine	Centennial Mandalong Pty Limited	Underground coal mine	Operational and project
Mannering Colliery	Centennial Mannering Pty Limited	Underground coal mine	Care and maintenance
Myuna Colliery	Centennial Myuna Pty Limited	Underground coal mine	Operational
Newstan Colliery	Centennial Newstan Pty Limited	Underground coal mine	Care and maintenance
Nu-Rock Resource Recovery Facility Project	Nu-Rock Technology Pty Ltd	Proposed resource recycling plants	Project
Pasminco and Incitec Consolidated Remediation Project	Pasminco Cockle Creek Smelter Pty Ltd	Contaminated land remediation	Operational
Tasman Underground Mine	Newcastle Coal Company Pty Ltd	Underground coal mine	Operational
Teralba Quarry	Metromix Pty Ltd	Quarry	Operational

Site	Owner	Site details	Status
Vales Point Power Station	Delta Electricity	Power station	Operational
Wallarrah 2 Coal Project	Wyong Areas Coal Joint Venture	Proposed underground coal mine	Project
West Wallsend Colliery	Oceanic Coal Australia Pty Limited	Underground coal mine	Operational
Westside Mine	Oceanic Coal Australia Pty Limited	Former open cut coal mine	Rehabilitation

For old underground workings in the region that are not part of the current water management system for a site, it has been assumed that these underground water storages are at equilibrium with the adjacent aquifer. Therefore, it is assumed there is no extraction from groundwater sources for these underground storages.

With regard to extractions, the Northern Operations Water and Salt Balance assessment is limited to considering the licensed extractions, i.e. those currently regulated by Water Access Licences (WALs) under the *Water Management Act 2000* (WM Act) or licences under the *Water Act 1912*. With regard to discharges, the assessment is limited to considering the licensed discharges, i.e. those regulated by EPLs and defined as Licenced Discharge Points (LDPs).

Potable water supply and wastewater discharges from sites have been excluded from the Northern Operations Water and Salt Balance assessment, as sites do not require extraction licences for the supply of potable water and wastewater discharges (although licensed) do not contribute to surface water sources as generating runoff from these activities is typically not permitted.

2.3 Availability of Information

In developing the Northern Operations Water and Salt Balance, information relating to the water and salt cycle at each site has been drawn upon from a range of sources. For Centennial-owned sites where detailed site information was available, GHD has developed detailed representations of the water cycle in the modelling software.

For other sites where GHD has not developed a modelled representation of an individual site, information and data relating to these sites has been determined from reviewing available information. This information and data is typically limited to publicly available material. GHD has endeavoured to interpret information presented in these reports as accurately as possible in the modelling undertaken, however cannot be responsible for inaccuracies due to misleading or absent information in the reports reviewed.

3 Legislation and Policy

This section provides an overview of the legislation, policies and guidelines relevant to the Northern Operations Water and Salt Balance, with particular reference to Myuna Colliery.

3.1 Water Act 1912

The *Water Act 1912* has historically been the main legislation managing water resources in NSW. The *Water Act 1912* governs access, trading and allocation of licences associated with both surface and underground water sources and is currently being progressively phased out and replaced by WSPs under the WM Act. The elements to which the *Water Act 1912* applies include extraction of water from a river, extraction of water from underground sources, aquifer interference and capture of surface runoff in dams.

The porous and fractured rock groundwater sources within the Study Area are still managed by the *Water Act 1912* at this point in time. A WSP for the North Coast Fractured and Porous Rock Groundwater Sources is currently under development and is due to commence in July 2015. Once the North Coast Fractured and Porous Rock Groundwater Sources WSP commences, groundwater extraction by mine workings at Myuna Colliery will require a WAL under this WSP.

3.2 Water Management Act 2000

The WM Act is progressively being implemented throughout NSW to manage water resources, superseding the *Water Act 1912*. The aim of the WM Act is to ensure that water resources are conserved and properly managed for sustainable use benefiting both present and future generations. It is also intended to provide formal means for the protection and enhancement of the environmental qualities of waterways and their in-stream uses as well as to provide for protection of catchment conditions. Fresh water sources throughout NSW are managed via WSPs under the WM Act. Key rules within the WSPs specify when licence holders can access water and how water can be traded.

An amendment to the WM Act (Section 60I) came into effect on 1 March 2013. This amendment provides that it is an offence for a person without an access licence to take, remove or divert water from a water source or relocate water from one part of an aquifer to another part of an aquifer in the course of carrying out a mining activity. Various activities are captured by the provisions of the amendment including mining, mineral exploration and petroleum exploration.

The alluvial water sources and surface water sources within the Study Area are covered under the WSP for the Hunter Unregulated and Alluvial Water Sources (HUA WSP). This WSP commenced in August 2009 and regulates the interception and extraction of surface water and alluvium within the defined WSP area.

The HUA WSP is categorised into four extraction management units (EMUs) and further broken down into water sources. The area covered by the WSP includes 39 surface water and alluvial groundwater sources. The HUA WSP water sources within the Study Area are shown in Figure 3.

The Myuna Colliery surface facilities area is located within the North Lake Macquarie water source. Table 2 identifies the water extraction entitlement for the North Lake Macquarie water source as well as the active licences at the commencement of the WSP in August 2009. The extraction limit is the yearly volume of water that can be extracted by all access licences within the water source.

Table 2 North Lake Macquarie Extraction Entitlement and Licences

Surface Water Entitlement (ML/year)	Surface Water Licences	Groundwater Entitlement (ML/year)	Groundwater Licences
1,216	10	—	—

Figure 4 shows the locations of where the HUA WSP applies within the Study Area to manage groundwater sources with respect to the groundwater WSPs that are currently being drafted.

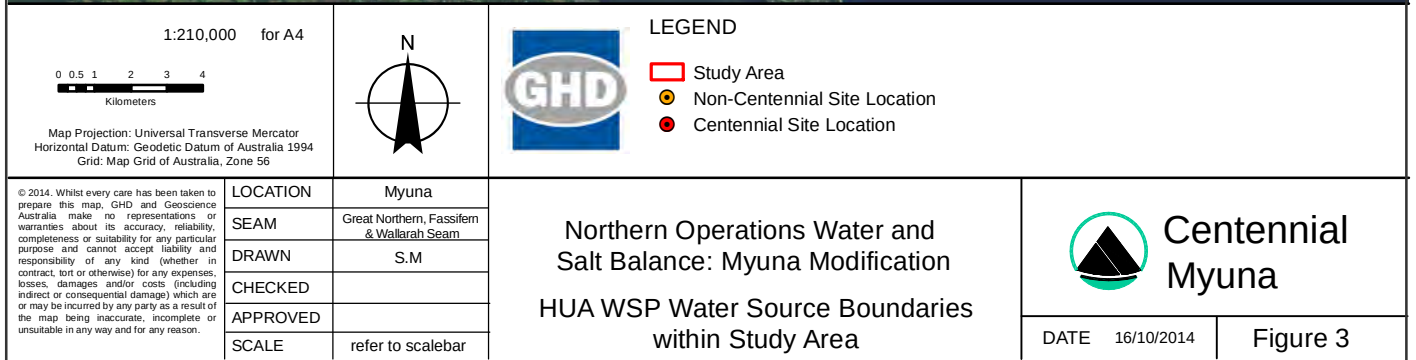
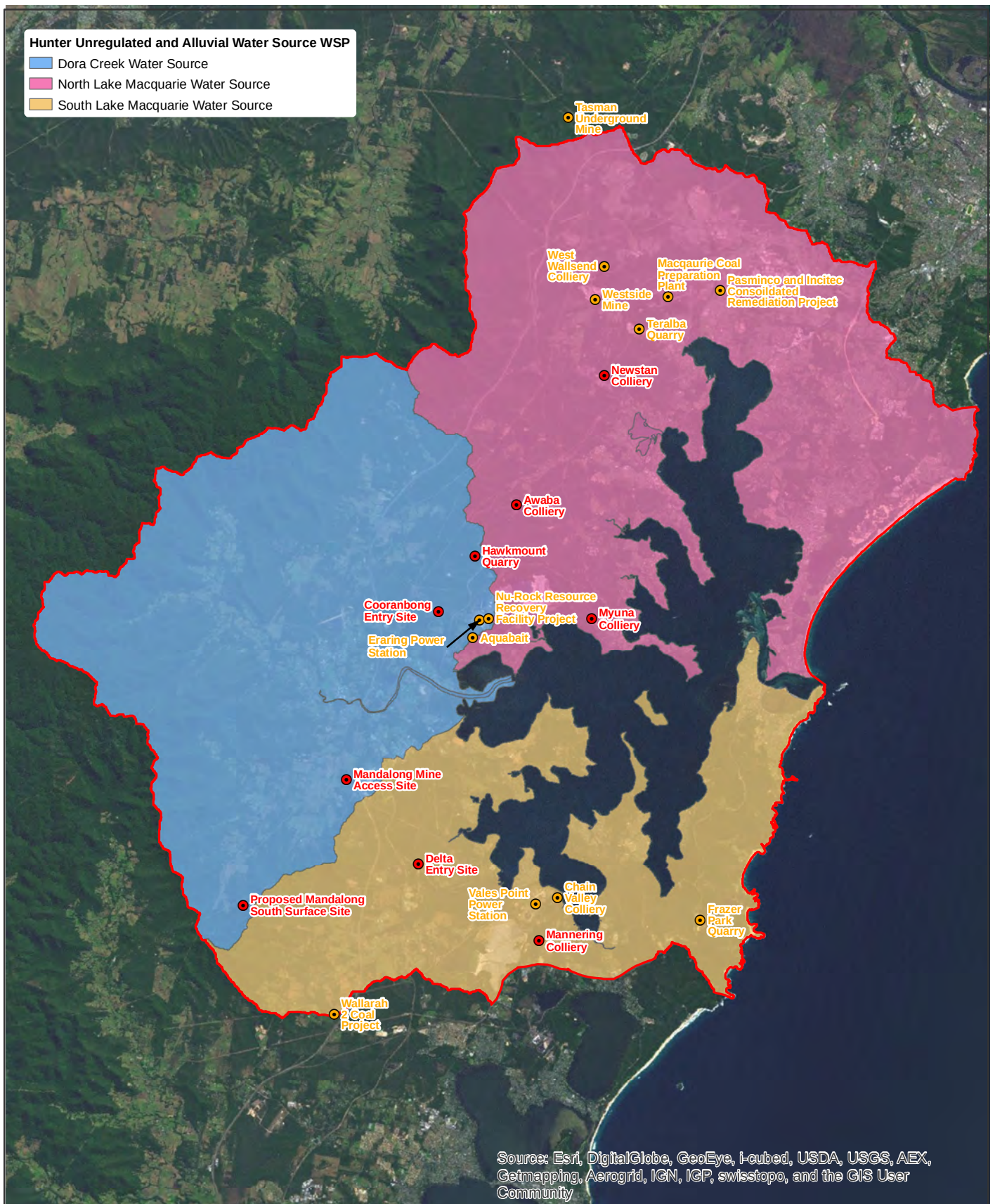
3.3 Protection of the Environment Operations Act 1997

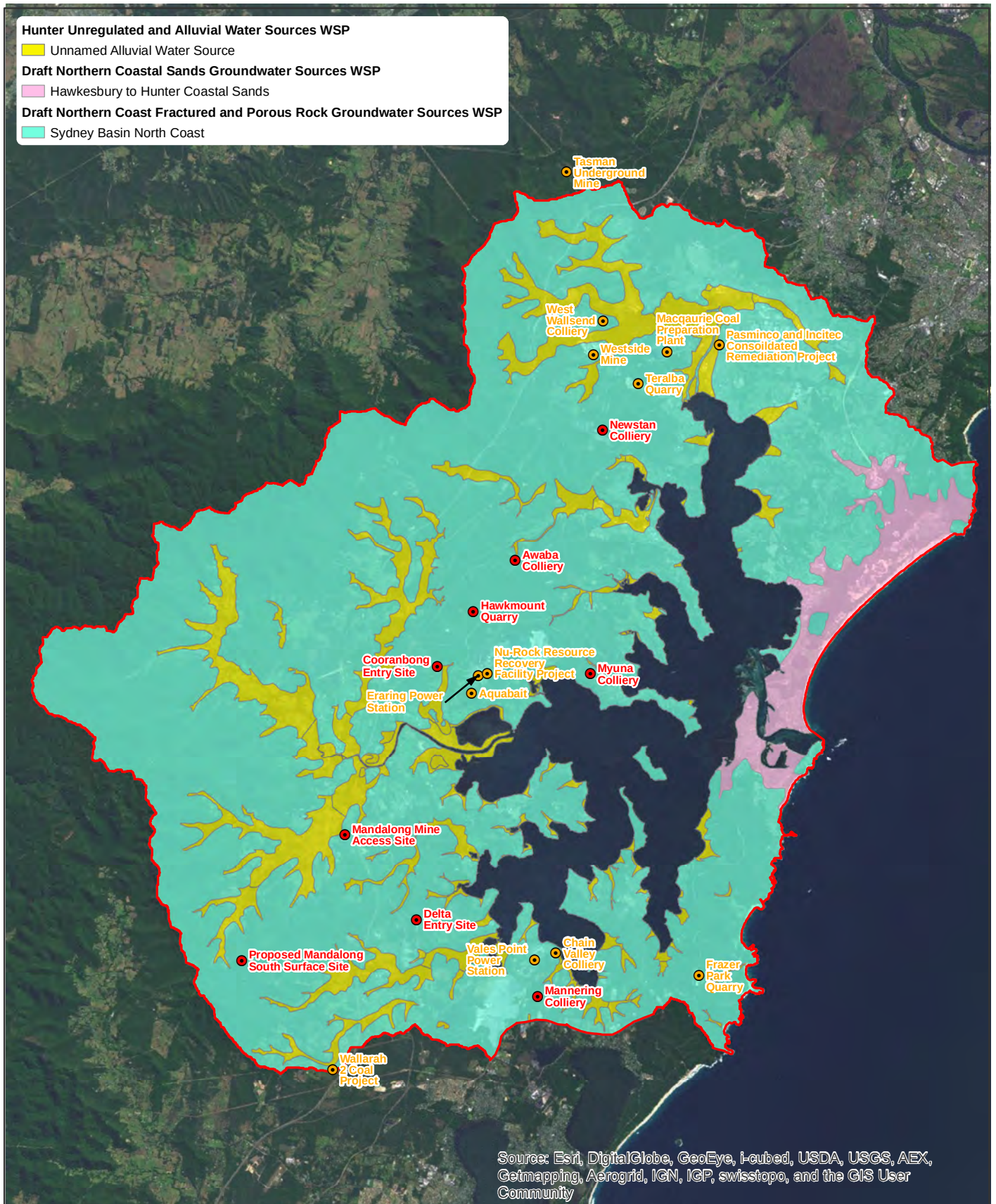
The *Protection of the Environment Operations Act 1997* (POEO Act) is administered by the NSW Environment Protection Authority (EPA), which is an independent statutory authority and the primary environmental regulator for NSW. The objectives of the POEO Act are to protect, restore and enhance the quality of the environment. Some of the mechanisms that can be applied under the POEO Act to achieve these objectives include reduction of pollution at source and monitoring and reporting of environmental quality. The POEO Act regulates and requires licensing for environmental protection, including for waste generation and disposal and for water, air, land and noise pollution.

Under the POEO Act, an EPL is required for premises at which a 'scheduled activity' is conducted. Schedule 1 of the POEO Act lists activities that are scheduled activities for the purposes of the Act. Table 3 details the EPL for Myuna Colliery, including relevant licensed discharge information.

Table 3 Environment Protection Licence Details – Myuna Colliery

Licence Number	EPA ID	Discharge Point	Discharge Point Name	Monitoring Requirements		Licenced Discharge Limit	Creek catchment
				Water quality	Volume		
366	9	Y	LDP B	O&G; pH; TSS	Y	13 ML/day	Wangi Creek
	10	Y	LDP A	–	N	No limit specified	Wangi Creek





Source: Esri, DigitalGlobe, GeoEye, I-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

1:210,000 for A4 00.51234 Kilometers Map Projection: Universal Transverse Mercator Horizontal Datum: Geodetic Datum of Australia 1994 Grid: Map Grid of Australia, Zone 56		N	LEGEND Study Area Non-Centennial Site Location Centennial Site Location	
© 2014. Whilst every care has been taken to prepare this map, GHD and Geoscience Australia make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.	LOCATION	Myuna	Northern Operations Water and Salt Balance: Myuna Modification Groundwater WSP Boundaries	
	SEAM	Great Northern, Fassifern & Wallarah Seam		
	DRAWN	S.M	DATE 14/10/2014 Figure 4	
	CHECKED			
	APPROVED			
SCALE	refer to scalebar			

GIS Filename: G:\2210105001\GIS\Maps\HUNTER\Myuna\Deliverables\2217524\2217524_WSB_004_GW_WSPBoundary_RevA.mxd

© LPI: DTDB, 2012; NSW Office of Water: Groundwater Data, 2013; ESRI: Aerial Imagery, 2012.

4 Northern Operations Water and Salt Balance - Methodology

4.1 Water Balance Modelling

The model used to represent the inputs and outputs from each site over time was GoldSim Version 10.50 (GoldSim Technology, 2011). This software is a graphical object oriented system for simulating either static or dynamic systems. It is like a 'visual spreadsheet' that allows one to visually create and manipulate data and equations.

GoldSim was used as the platform for data from all sites to be entered into. All the sites were simulated over time in GoldSim which statistically summarised selected outputs from the modelled systems.

4.1.1 Time Steps and Simulation Timeline

The GoldSim model simulated conditions for all identified sites from current conditions in 2014 to 2050 using daily time steps. Daily time steps were used for the modelling as daily rainfall data was the shortest period of data available and changes in operational conditions are typically made on a daily (or shorter) basis.

Groundwater extraction has been accounted for at all sites up to recovery of the coal seams post-mining. In some cases, this recovery period has extended beyond 2050. Since groundwater inflow is the only water transfer during this period it was not necessary to model using daily time steps in GoldSim. Instead, groundwater inflows between 2050 and 2200 have been summed for Centennial-owned and non-Centennial sites and it was assumed that this water would remain within the coal seam as storage rather than be transferred to the surface.

4.1.2 Probabilistic Modelling

Rainfall data was obtained as SILO Patched Point Data from the Queensland Climate Change Centre of Excellence. SILO Patched Point Data is based on historical data from a particular Bureau of Meteorology (BOM) station with missing data 'patched in' by interpolation with nearby stations. For this assessment, SILO data was obtained for BOM Cooranbong (Avondale) Station (station number 61012). The rainfall data was selected based on the length and quality of the data record and proximity to the sites assessed.

The 113 realisations were applied as the historical rainfall data extended from January 1901 to December 2013, which represents 113 years of complete rainfall data available. The 113 years of rainfall data provides 113 rainfall patterns as the seasonality in rainfall is maintained for each model run, e.g. the 1st January in the model was simulated with 1st January historical rainfall data. For each realisation, a continuous pattern of historical rainfall was applied over the simulation timeline.

When the end of the continuous historical rainfall record was reached in a realisation, the rainfall looped back to the start of the rainfall record.

The above repetition process provided 113 values for each simulated element in the model, for each day of the simulation timeline. Each extraction, discharge or transfer was then statistically assessed to provide estimates of the mean, 10th percentile and 90th percentile annual totals for each year over the simulation timeline where appropriate.

4.1.3 Hydrogeological Modelling

Extractions from groundwater sources were derived separately from GoldSim on a site-by-site basis. For the purposes of this study, groundwater extraction has been defined as the removal of groundwater from a groundwater source or aquifer, either by direct removal for use via a production bore or by incidental

flow of groundwater from an aquifer into mine workings during and after mining. Groundwater extraction includes the pumping of underground water from flooded mine workings in equilibrium with the surrounding strata as well as the removal of water from perched aquifers recharged directly from rainfall infiltration.

The removal of water from the collection system within mine workings is regarded as dewatering and is considered to be an operational transfer of water at a mining operation rather than the extraction from a groundwater source. In the same way, the transfer of mine water into mine workings for operational or water storage purposes is also considered to be an operational transfer of water and not an injection into a groundwater source.

For the majority of sites with groundwater extractions, including Myuna Colliery, a site hydrogeological model has been developed in the past by GHD or others to predict current and future inflow or extraction of groundwater. Most hydrogeological models have been developed in a version of MODFLOW, a three-dimensional finite difference groundwater flow model from the United States Geological Survey and one of the industry standard codes for numerical groundwater modelling.

Details regarding the MODFLOW hydrogeological model for Myuna Colliery and the groundwater inputs into the Northern Operations Water and Salt Balance are attached.

4.2 Salt Balance Modelling

The salt balance was developed as an extension of the water balance within GoldSim. The structure of the water balance model remained unchanged, with expected concentrations of salt applied to inputs within the model. The salt balance provides the expected salt loads and concentration of salt associated with each water transfer within the water balance. Chemical reactions have not been incorporated into the salt balance modelling. Salt transfers were simulated in parallel with the water balance model.

Inputs to the water and salt balance model were assigned a specific concentration of salt depending on the source of water. Salt concentrations were based upon recorded water quality data and typical concentration values for similar sites, usually provided in units of $\mu\text{S}/\text{cm}$. A conversion factor of 0.67 was used to convert salinity data in $\mu\text{S}/\text{cm}$ to mg/L as recommended by the Queensland Department of Natural Resources and Water (DNRW, 2007).

5 Northern Operations Water and Salt Balance - Results

The Northern Operations Water and Salt Balance results for Myuna Colliery (3 Mtpa scenario) are presented in this section, as well as the regional results for each water source. Results for other sites within the Study Area are reported in GHD (2014). The results for Myuna Colliery presented in GHD (2014) relate to the current approved conditions (2 Mtpa scenario).

5.1 Myuna Colliery Results

5.1.1 Water Balance

The estimated volume of annual groundwater extractions and surface water discharges at Myuna Colliery over the simulation timeline are provided in Figure 5 to Figure 7. The following three graphs are shown:

- Extraction from the Draft North Coast Fractured and Porous Rock Groundwater Sources WSP (Figure 5).

- Licensed discharge from Myuna Colliery to the North Lake Macquarie water source (Figure 6).
- Net extraction or discharge (Figure 7).

The net extraction or discharge of Myuna Colliery is also provided which is equal to the estimated discharges through LDPs minus the estimated extractions. This provides an indication of the net water and salt consumption of Myuna Colliery and the net withdrawal or addition of water and salt removed from the water cycle.

Figure 5 reflects the groundwater extraction into the underground workings for the proposed 3 Mtpa scenario. Total groundwater extraction is predicted to peak at 3,200 ML/year in 2020. Note that the total groundwater extraction includes the in-situ coal moisture in addition to predicted groundwater inflows into the workings.

Under proposed conditions, continuous discharges from Myuna Colliery are predicted to stop by 2026 (Figure 6). The peak average annual discharge prior to 2026 is predicted to be 2,050 ML/year. The modelling indicates that the current volumetric discharge limits at LDP A and LDP B (Table 3) are sufficient for the life of the mine. As shown in Figure 7, Myuna Colliery is a net extraction site with excess underground water used at the pit top area.

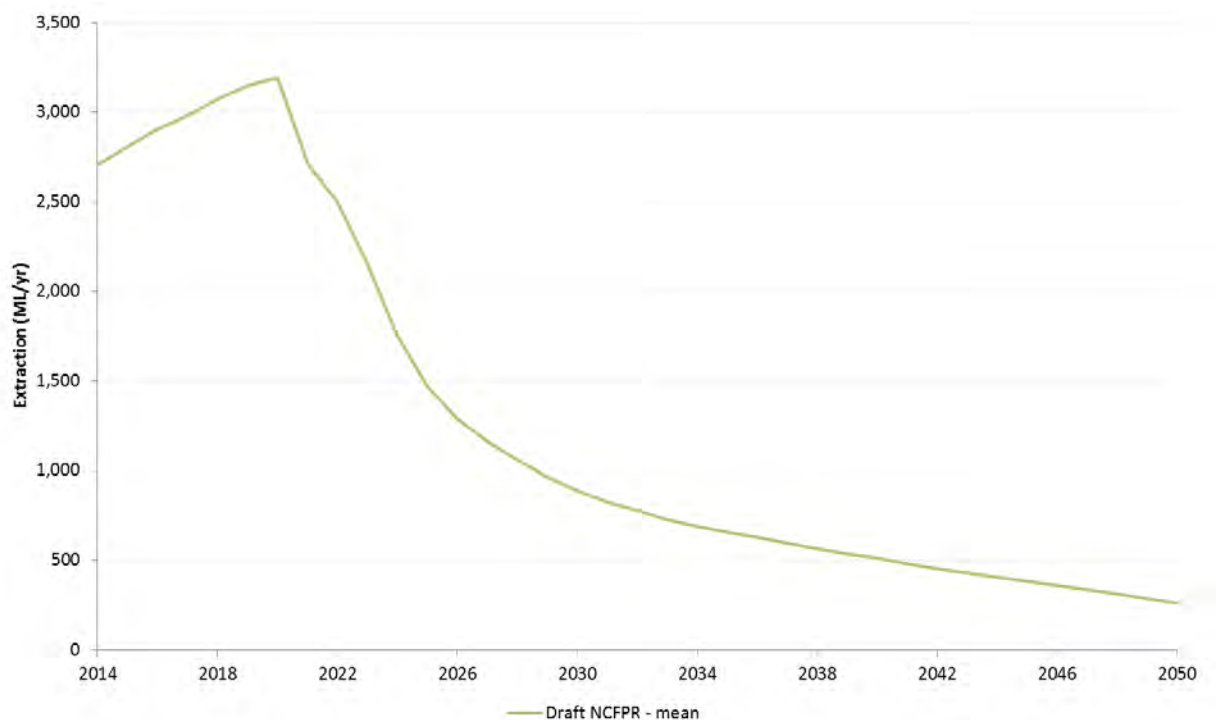


Figure 5 Myuna Colliery – Groundwater Extraction

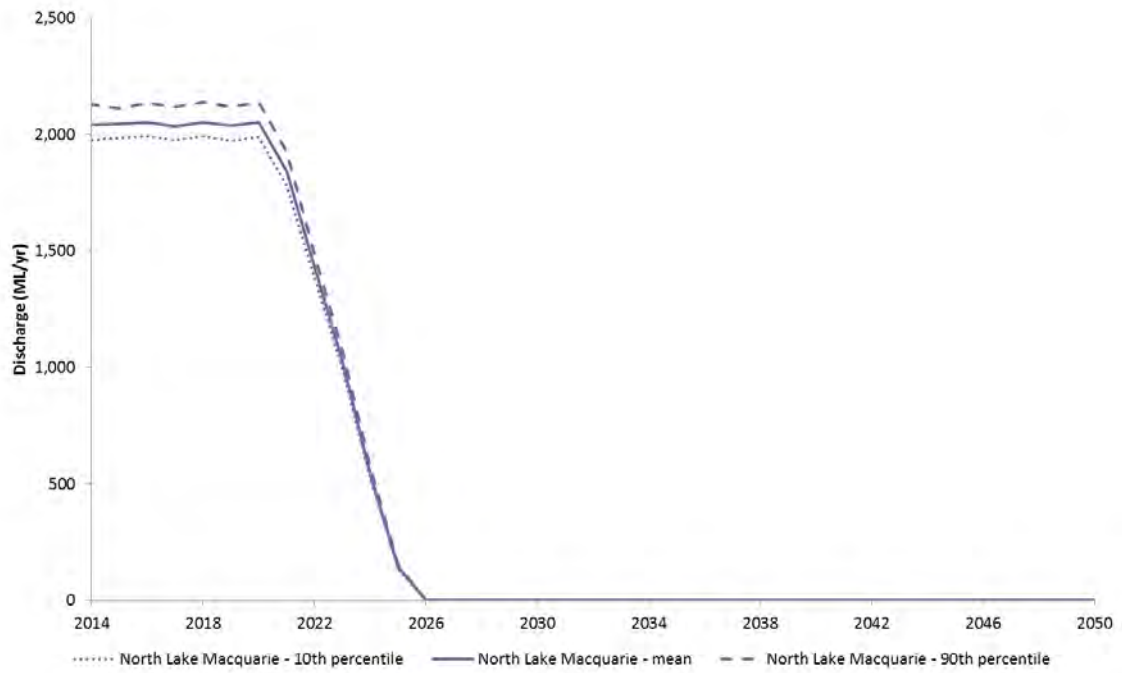


Figure 6 Myuna Colliery – Surface Water Discharge

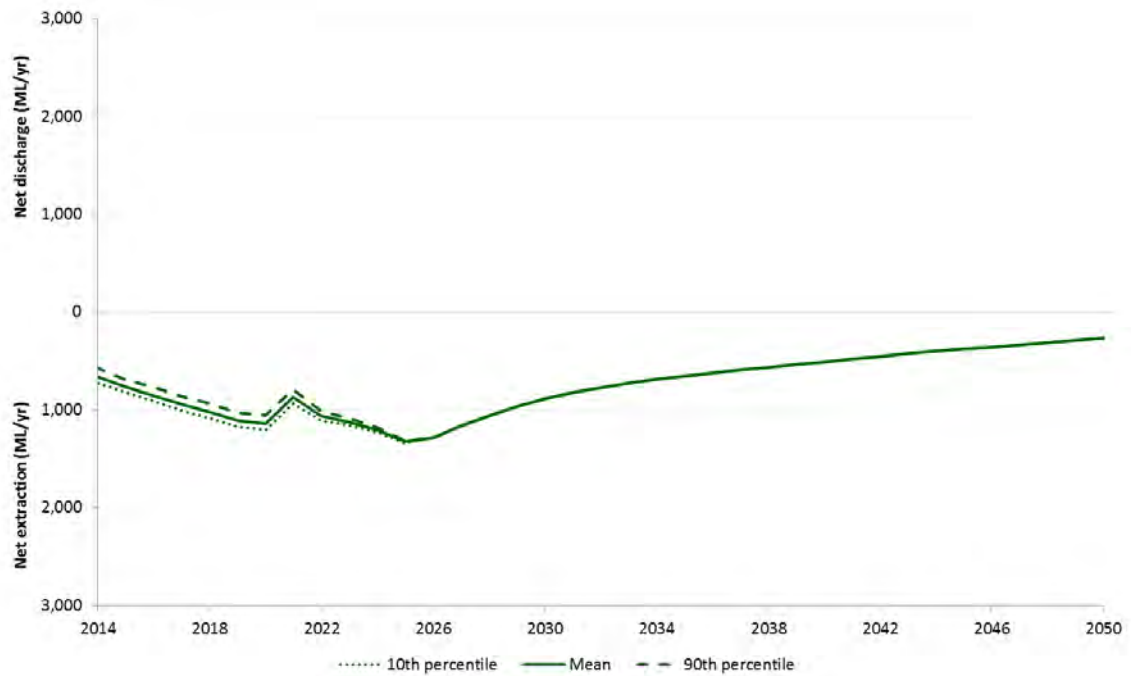


Figure 7 Myuna Colliery – Net Extraction/Discharge

5.1.2 Salt Balance

The estimated mass of salt (tonnes per year) and electrical conductivity (EC) associated with annual groundwater extractions and surface water discharges at Myuna Colliery are provided in Figure 8 to Figure 11. Figure 12 shows the net salt extraction/discharge at Myuna Colliery in terms of salt mass.

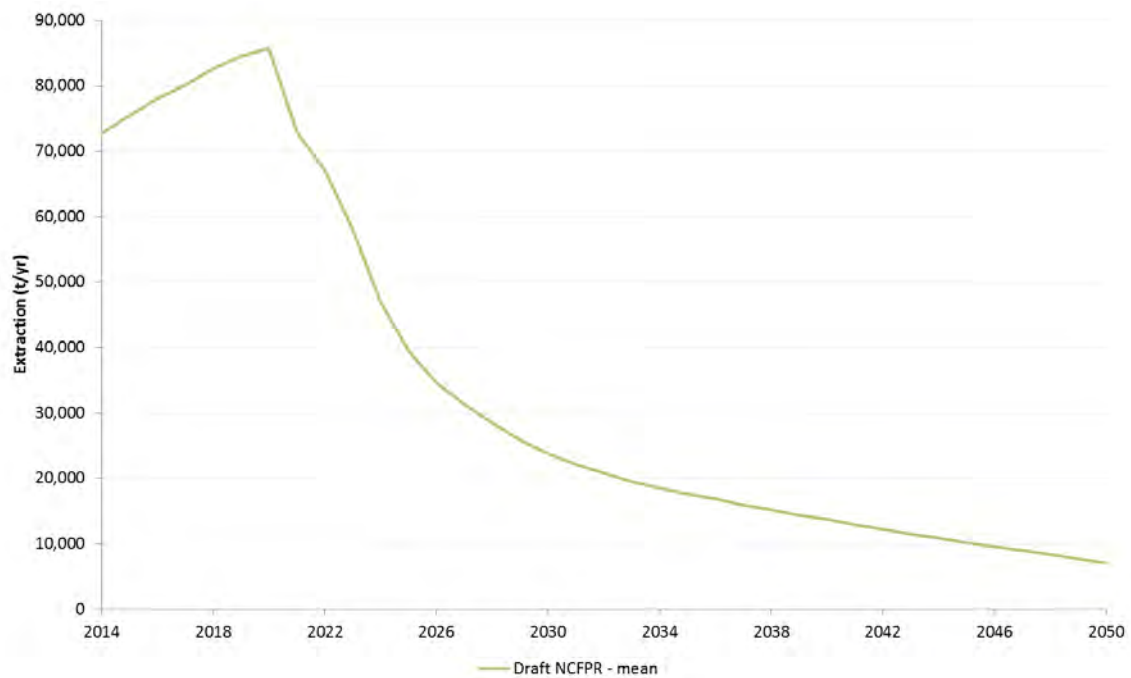


Figure 8 Myuna Colliery – Groundwater Extraction Salt Mass

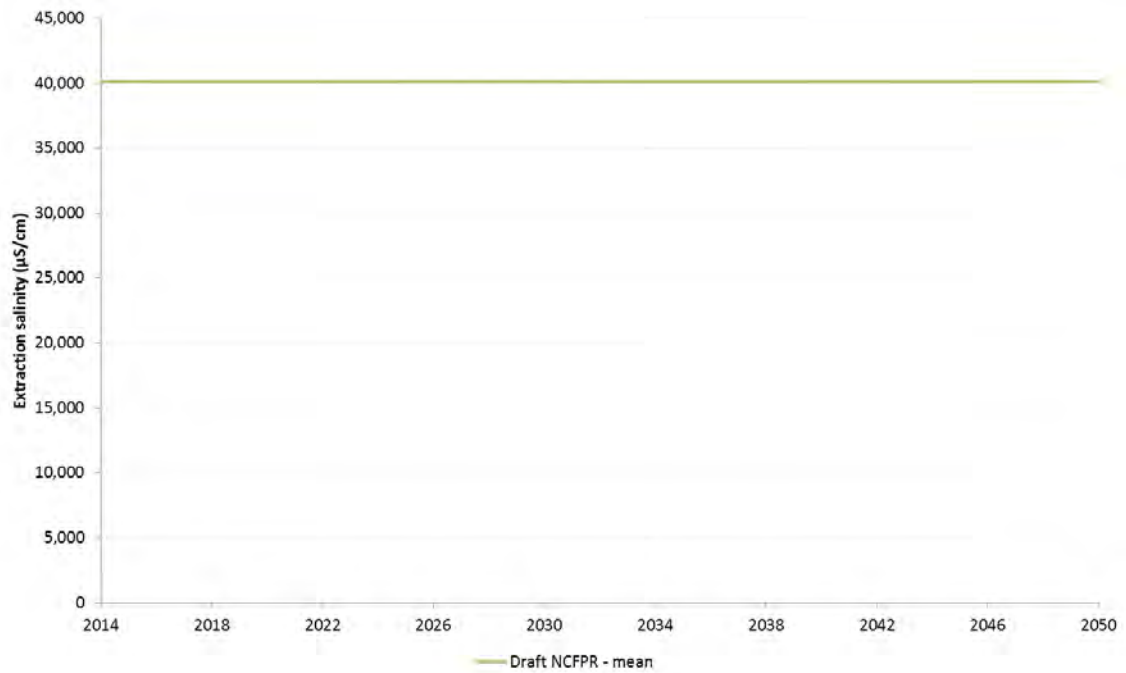


Figure 9 Myuna Colliery – Groundwater Extraction EC

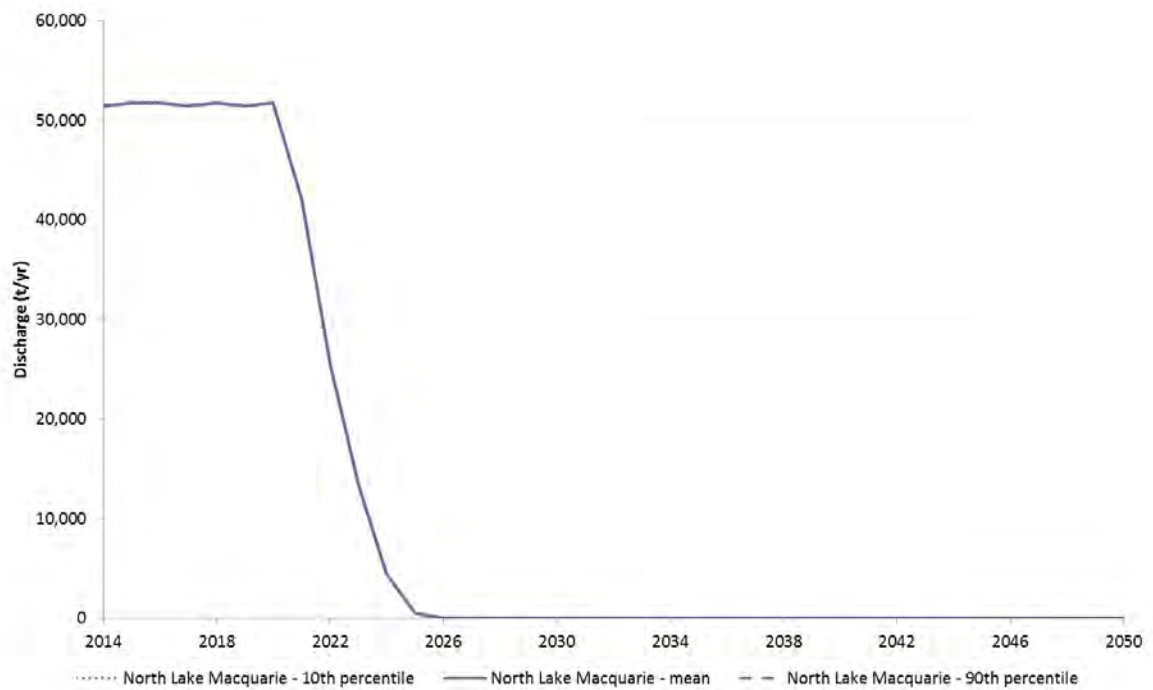


Figure 10 Myuna Colliery – Surface Water Discharge Salt Mass

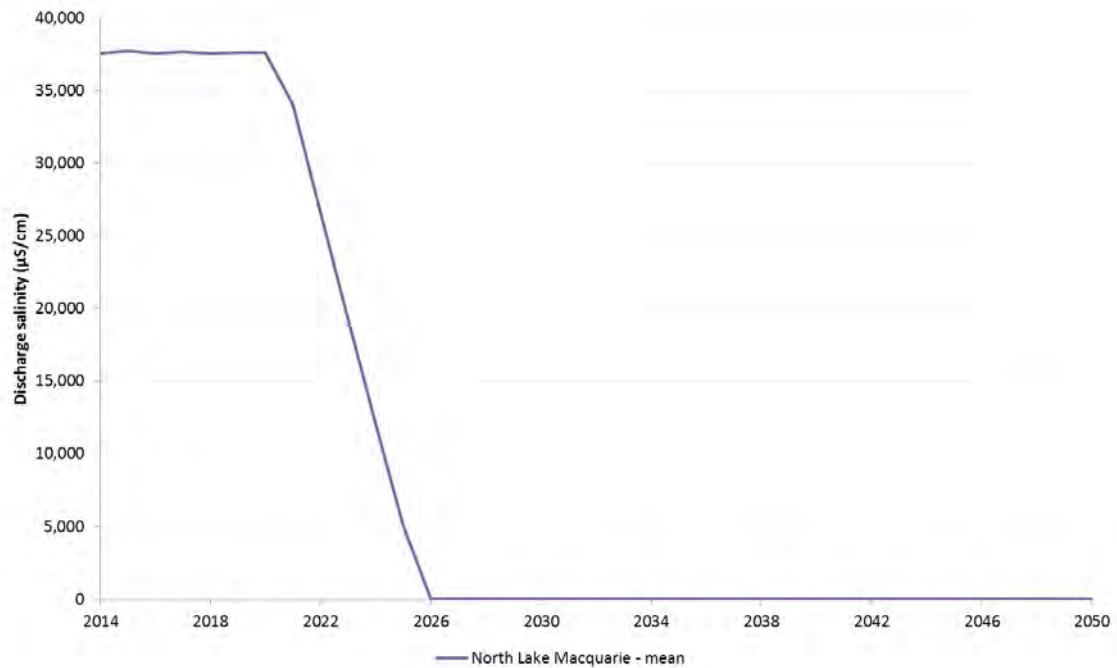


Figure 11 Myuna Colliery – Surface Water Discharge EC

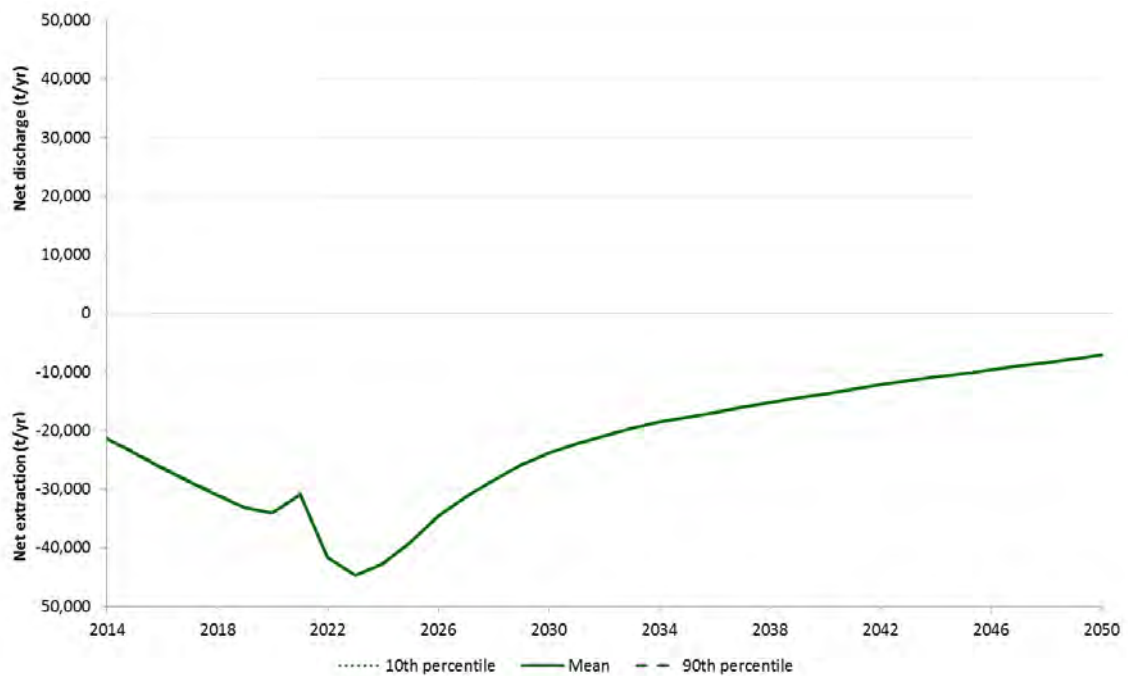


Figure 12 Myuna Colliery – Net Extraction/Discharge Salt Mass

5.2 Water Source Results

5.2.1 Water Balance

Groundwater Extraction

The estimated annual groundwater extractions from the North Coast Fractured and Porous Groundwater Source in the Study Area between 2014 and 2050 are presented in Figure 13. The figure presents the contribution of all assessed sites in the Study Area, including Centennial-owned sites.

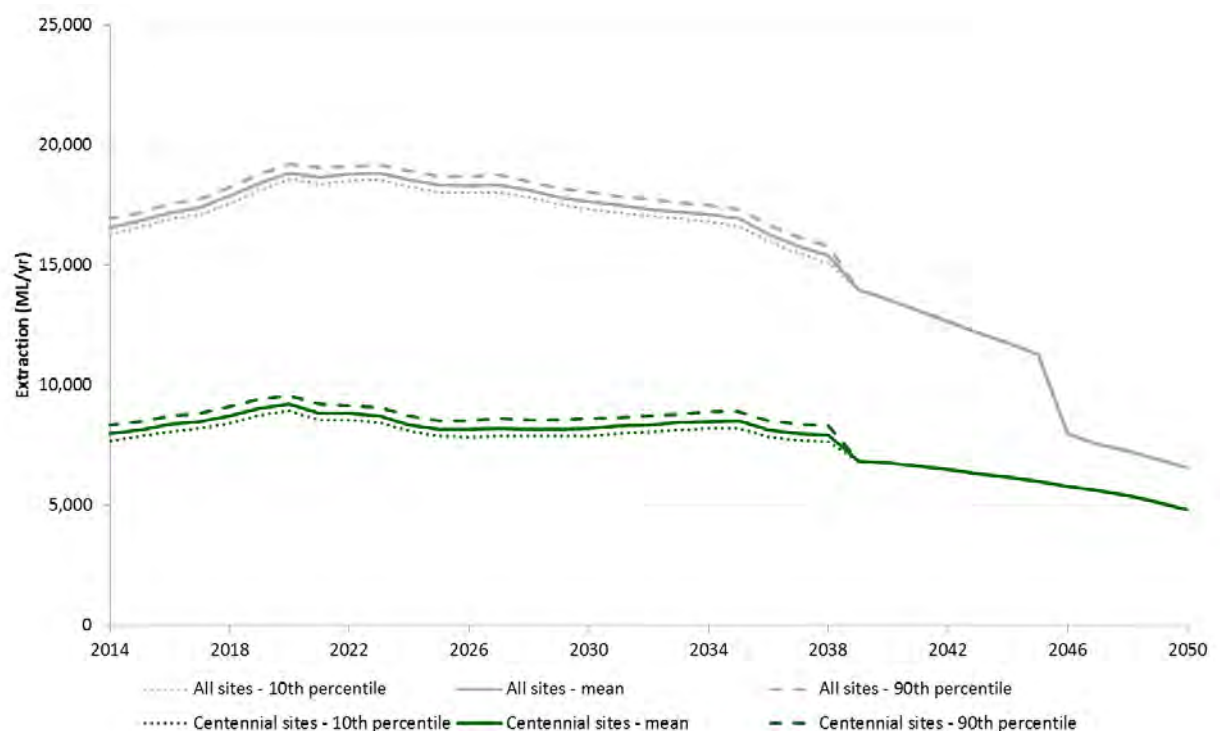


Figure 13 North Coast Fractured and Porous Rock Groundwater Sources – Estimated Volume of Aggregate Extractions

As shown in Figure 13 current total groundwater extractions from the North Coast Fractured and Porous Rock Groundwater Sources within the Study Area are estimated to be approximately 16,600 ML/year on average, of which approximately 8,000 ML/year on average is extracted by Centennial-owned sites (including approximately 2,700 ML/year from Myuna Colliery). Peak extraction from the groundwater source is predicted to occur in 2020 at an average rate of approximately 18,900 ML/year. Extraction of groundwater from Centennial-owned sites is predicted to peak in 2020 at an average of approximately 9,200 ML/year. By the end of the assessment period in 2050, groundwater extraction from Centennial-owned sites is predicted to occur at an average rate of approximately 4,800 ML/year. Overall, groundwater extraction at Myuna Colliery represents up to approximately 15% of total groundwater extraction from the North Coast Fractured and Porous Rock Groundwater Sources within the Study Area. There are no extractions from the alluvium within the HUA WSP from Centennial-owned or non-Centennial sites.

Groundwater extraction over the post-2050 re-pressurisation period was calculated separately from GoldSim. Six sites were considered in this assessment including Mandalong Mine, Myuna Colliery, Newstan Colliery, Tasman Underground Mine, Wallarah 2 Coal Project and West Wallsend Colliery. Predicted groundwater extraction from the North Coast Fractured and Porous Rock Groundwater Sources over the period 2050 to 2200 is shown in Figure 14 and provides an indication of WAL requirements over this period. The contribution from Myuna Colliery is generally less than 15% of the total volume of groundwater extracted.

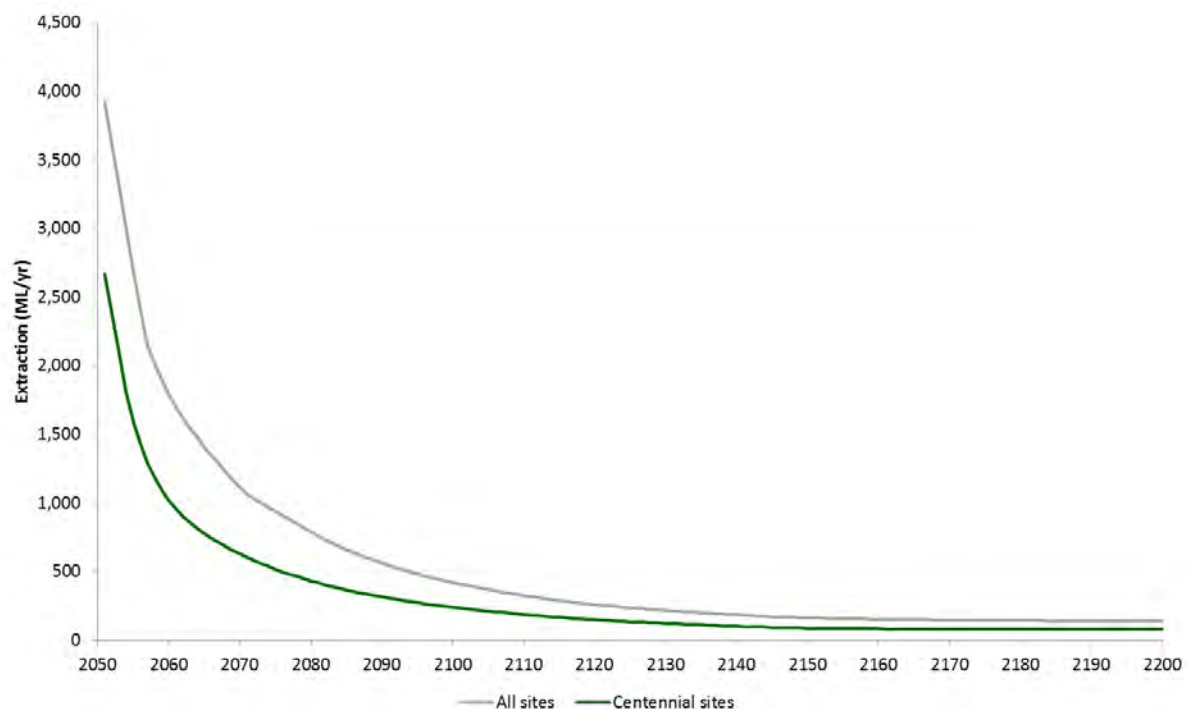


Figure 14 Estimated Volume of Groundwater Extraction for Recovery Period up to 2200

Surface Water Discharges

The estimated annual discharges from coal mining and other assessed operations to the North Lake Macquarie water source of the HUA WSP over the period from 2014 to 2050 are presented in Figure 15 and Figure 16. Each figure presents the contribution of Centennial-owned sites as well as the contribution of all assessed sites in the water source. Scenarios with and without discharges from Eraring Power Station are presented, as this site contributes significantly larger volumes of water to the water source when compared to other sites assessed.

The information presented in these figures provides an indication of the distribution of extracted groundwater to surface water sources. It should be noted when reviewing these figures that catchment runoff to the LDPs contribute to the discharge and therefore estimates provided are not completely related to groundwater extractions.

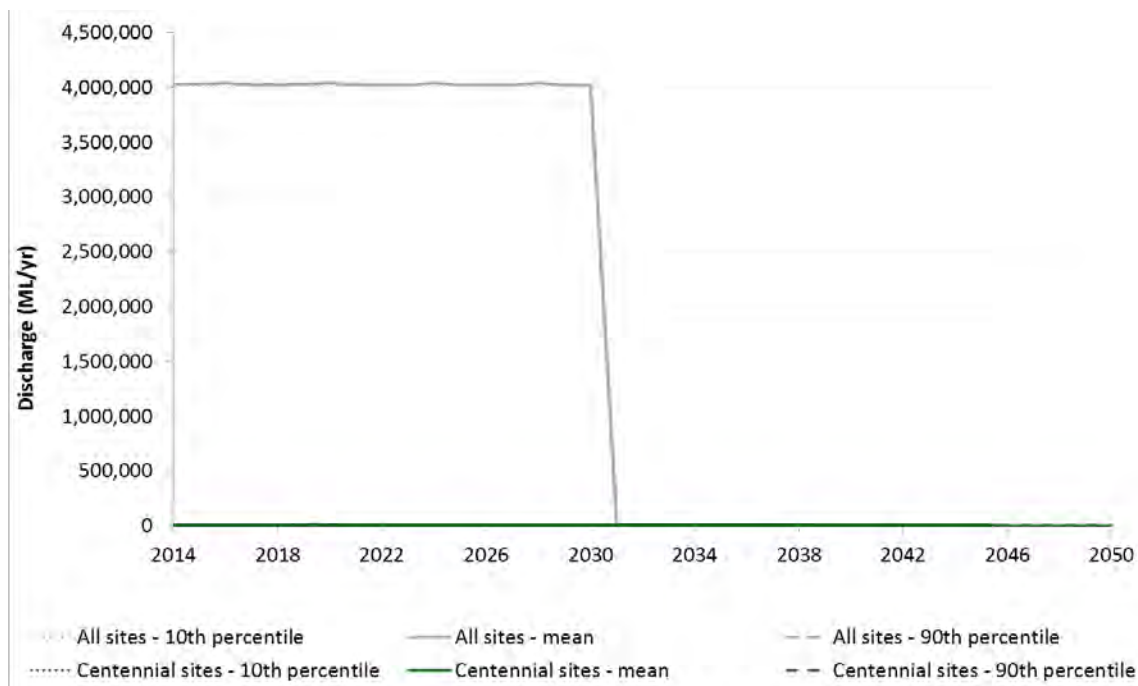


Figure 15 North Lake Macquarie Water Source – Estimated Volume of Aggregate Discharges

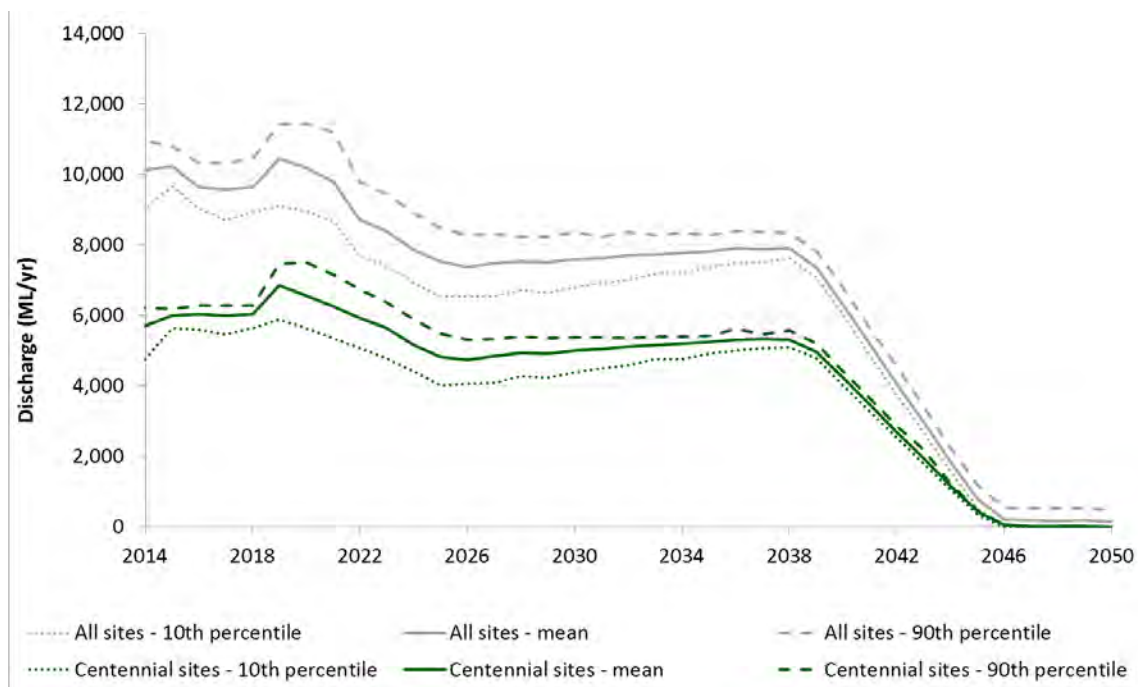


Figure 16 North Lake Macquarie Water Source – Estimated Volume of Aggregate Discharges (Without Contribution of Eraring Power Station)

As seen in Figure 15 and Figure 16, the total discharges to the North Lake Macquarie Water Source are dominated by discharges from Eraring Power Station. Current total discharges are estimated to be 4.0 GL/year on average. This is expected to decrease to approximately 7,600 ML/year after 2030, when Eraring Power Station is expected to cease discharging with decommissioning of the power station.

When discharges from Eraring Power Station are excluded, total discharges to the North Lake Macquarie Water Source are currently estimated to be approximately 8,900 ML/year. Peak discharge to the North Lake Macquarie Water Source is predicted to occur in 2019 at an average rate of 10,400 ML/year. Peak discharge by Centennial-owned sites is expected to occur in 2019 at approximately 6,900 ML/year. By the end of the assessment period in 2050, discharge from all assessed sites is minimal, with approximately 1 ML/year discharged by Centennial-owned sites. Overall, discharge from Myuna Colliery generally represents up to 20% of total discharge to the North Lake Macquarie Water Source (excluding contributions from Eraring Power Station).

5.2.2 Salt Balance

Groundwater Extraction

The estimated annual salt mass (tonnes per year) and EC of groundwater extractions from the North Coast Fractured and Porous Rock Groundwater Sources within the Study Area over the period from 2014 to 2050 are presented in Figure 17 and Figure 18. Both figures present the contribution of Centennial-owned operations as well as the contribution of all assessed sites.

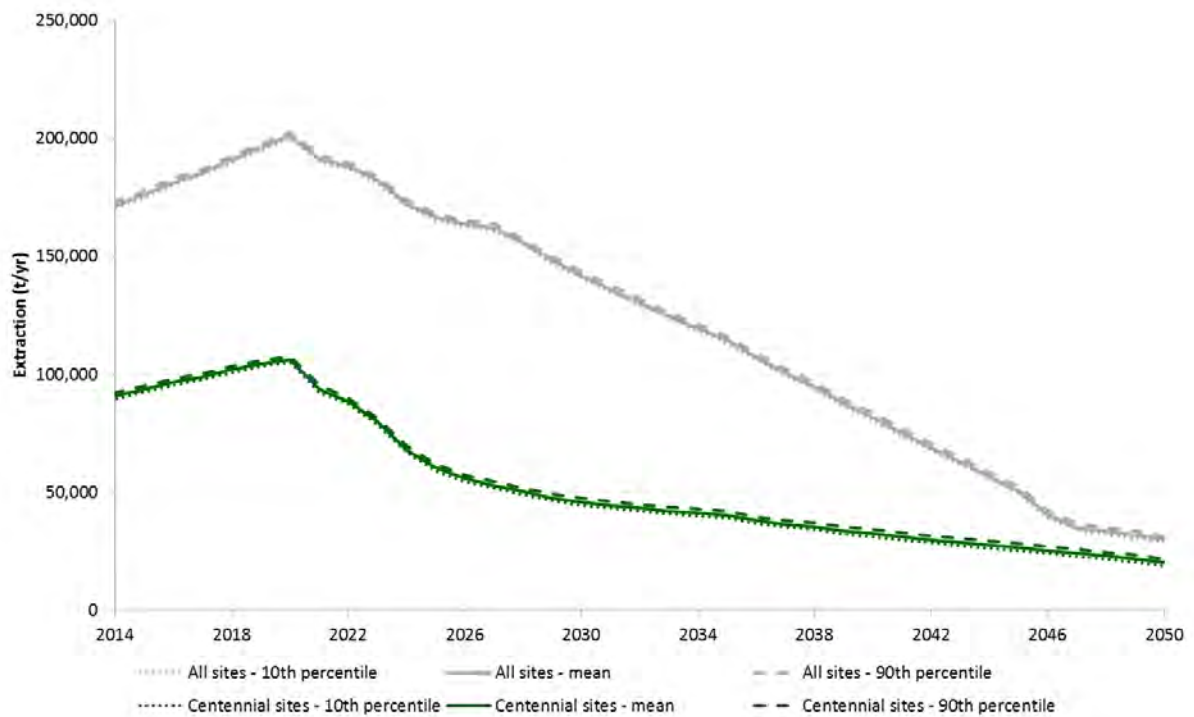


Figure 17 North Coast Fractured and Porous Rock Groundwater Source – Estimated Salt Mass of Aggregate Extractions

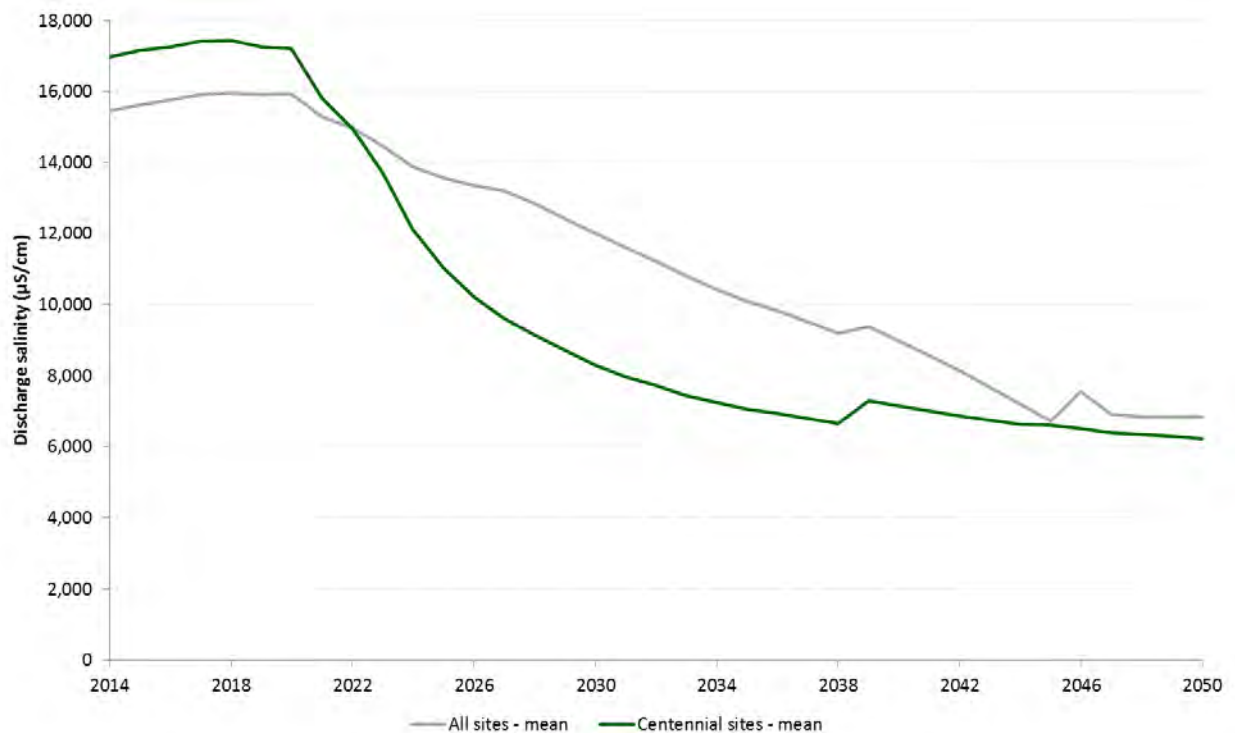


Figure 18 North Coast Fractured and Porous Rock Groundwater Source – Estimated EC of Aggregate Extractions

As shown in Figure 17 and Figure 18, current extractions of salt associated with groundwater extraction from the North Coast Fractured and Porous Rock Groundwater Source are estimated to be approximately 170,300 t/year on average with salinity of approximately 15,500 µS/cm. Of this, approximately 90,700 t/year of salt with salinity of approximately 17,000 µS/cm is extracted by Centennial-owned sites. The majority of Centennial Coal's contribution to total salt extraction is from Myuna Colliery.

Salt extraction associated with groundwater extraction by all sites is expected to peak in 2020 at a rate of approximately 201,200 t/year with salinity of approximately 15,900 µS/cm. Salt associated with the extraction of groundwater by Centennial-owned sites is predicted to peak in 2020 at approximately 106,200 t/year (coinciding with the peak at Myuna Colliery) with salinity of 17,200 µS/cm. Over the period up to 2020, approximately 40% of total salt in groundwater extraction in the Study Area is from Myuna Colliery. By the end of the simulation period in 2050, extractions of salt from the groundwater source across all sites is largely attributable to Centennial-owned sites at a rate of approximately 20,100 t/year with salinity of approximately 6,200 µS/cm.

Surface Water Discharges

The estimated annual salt mass and salinity of discharges from operations in the Study Area to the North Lake Macquarie Water Source over the period from 2014 to 2050 are presented in Figure 19 to Figure 22. Each figure presents the contribution of Centennial-owned operations as well as the contribution of all assessed sites.

Figure 19 and Figure 20 present the mass of salt associated with discharges with and without the contribution from Eraring Power Station, while Figure 21 and Figure 22 present the EC of discharges with and without Eraring Power Station.

With discharges from Eraring Power Station considered, current total discharges of salt into the North Lake Macquarie Water Source are estimated to be approximately 148 Mtpa on average with salinity of approximately 56,000 $\mu\text{S}/\text{cm}$. This is predicted to decrease to approximately 10,600 t/year with salinity of approximately 2,100 $\mu\text{S}/\text{cm}$ after 2030, when Eraring Power Station is expected to cease discharging with decommissioning of the power station.

Not considering discharges from Eraring Power Station, current total discharges of salt to North Lake Macquarie Water Source are estimated to be approximately 61,700 t/year with salinity of 9,100 $\mu\text{S}/\text{cm}$. Of this, approximately 53,800 t/year of salt with salinity of 14,100 $\mu\text{S}/\text{cm}$ is discharged by Centennial-owned sites. Salt discharged from all sites is predicted to peak in 2020 at a rate of approximately 63,700 t/year with salinity of approximately 9,300 $\mu\text{S}/\text{cm}$. Salt associated with Centennial-owned sites is predicted to peak in 2019 at approximately 56,500 t/year with salinity of approximately 12,300 $\mu\text{S}/\text{cm}$. Over the period to 2020, over 80% of total salt discharged to the North Lake Macquarie Water Source is from Myuna Colliery.

By the end of the assessment period in 2050, discharges of salt to the North Lake Macquarie Water Source by Centennial-owned sites is expected to decrease significantly to a rate of 1 t/year with salinity of approximately 1,400 $\mu\text{S}/\text{cm}$.

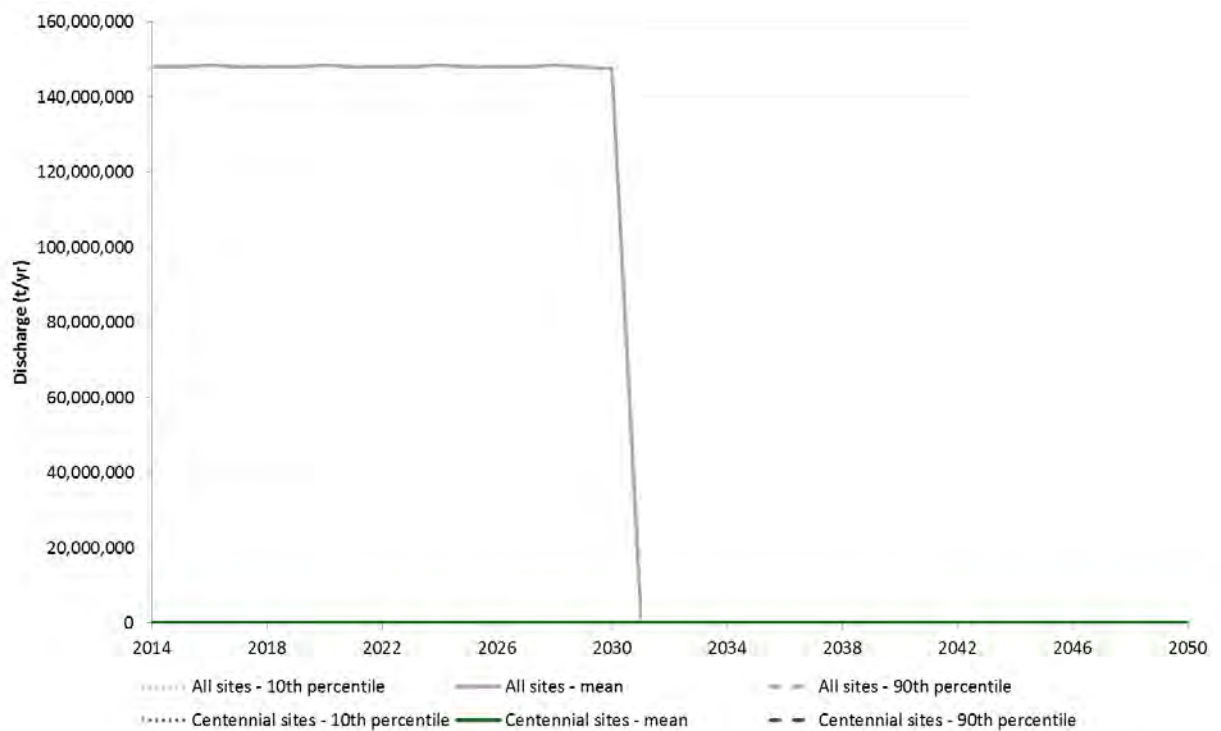


Figure 19 North Lake Macquarie Water Source – Estimated Salt Mass of Aggregate Discharges

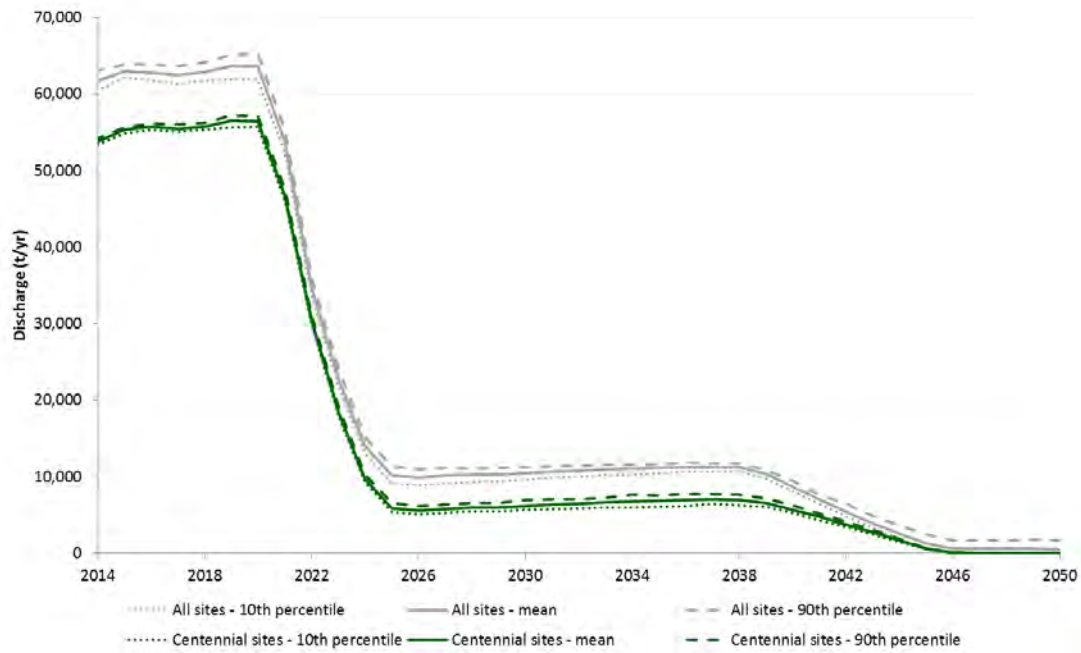


Figure 20 North Lake Macquarie Water Source – Estimated Salt Mass of Aggregate Discharges (Without Contribution of Eraring Power Station)

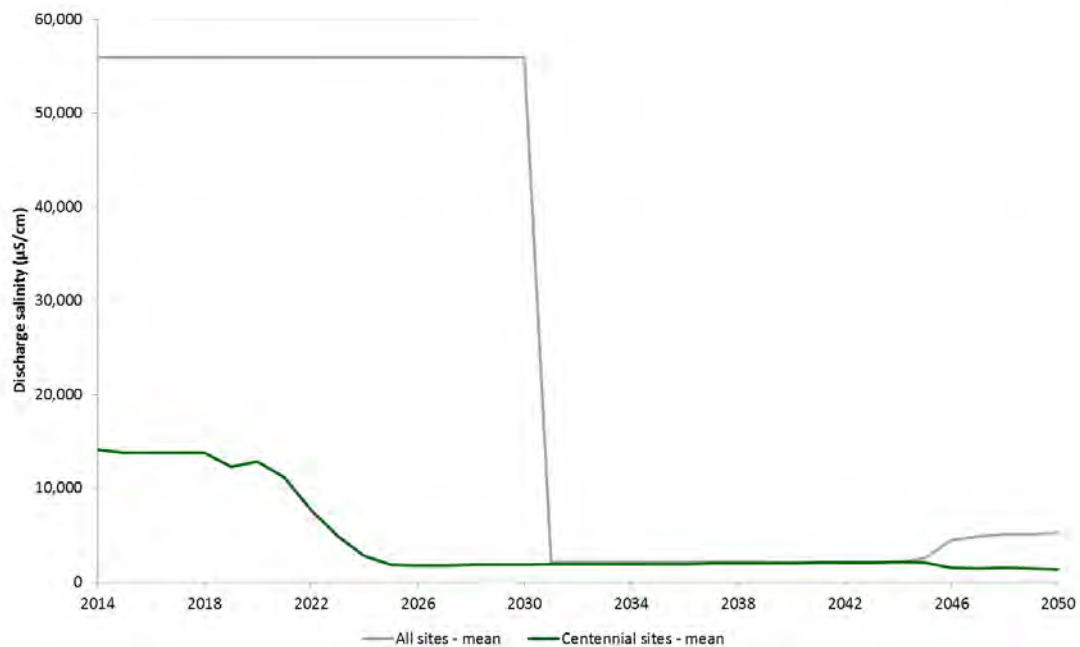


Figure 21 North Lake Macquarie Water Source – Estimated EC of Aggregate Discharges

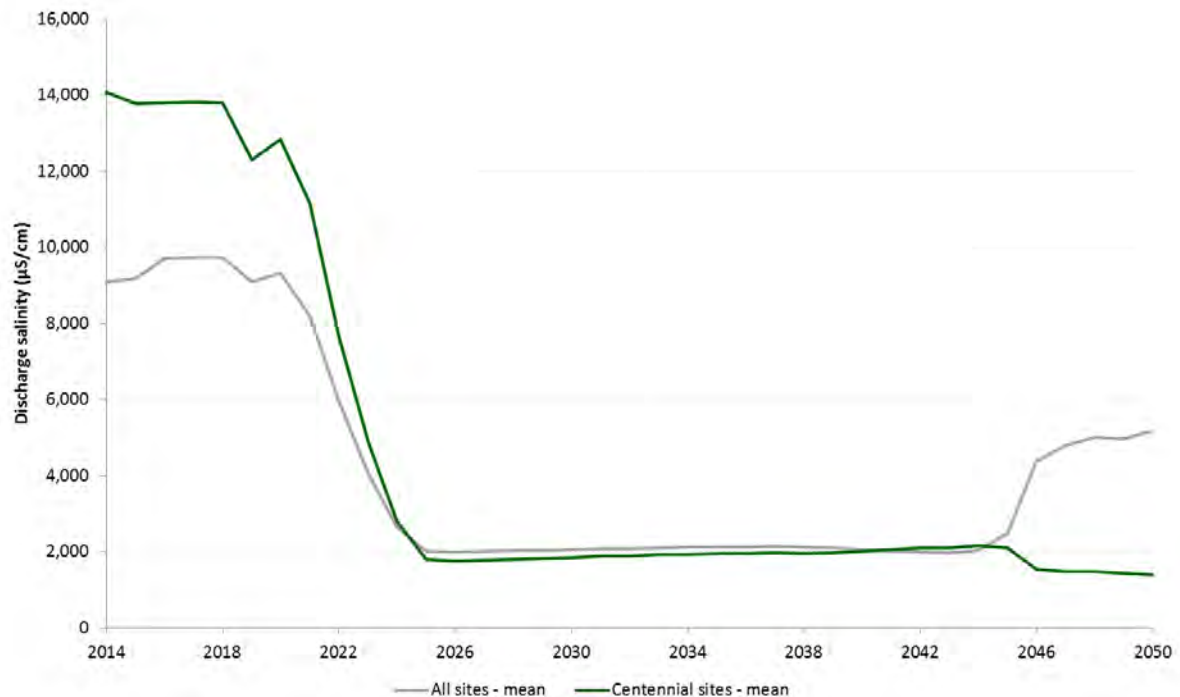


Figure 22 North Lake Macquarie Water Source – Estimated EC of Aggregate Discharges (Without Contribution of Eraring Power Station)

5.3 Modelling Limitations

GHD has developed the Northern Operations Water and Salt Balance model based on information supplied by Centennial Coal and publicly available information. Where data was not available, GHD has made assumptions as appropriate. The limitations of the model and an indication of confidence levels of the data used to develop the models are presented in GHD (2014).

6 Conclusions

The Northern Operations Water and Salt Balance (GHD, 2014) was developed to assist Centennial Coal to understand the potential cumulative impact of current and future operations on the regional water and salt balance by considering the cumulative water inputs and outputs of both Centennial-owned and non-Centennial operations in the region. The original hydrogeological model for Myuna Colliery (GHD, 2010) was revised as part of the development of this regional water and salt balance. A report detailing the revised hydrogeological model for Myuna Colliery is attached.

Centennial Myuna is in the process of applying for a Modification to Project Approval 10_0080 to increase the extraction rate to 3 Mtpa of ROM coal within CCL762 and ML1370. The Northern Operations Water and Salt Balance has been run for this 3 Mtpa scenario for Myuna Colliery to assesses groundwater extraction and surface water discharge at Myuna Colliery in the context of the regional water and salt balance.

Current groundwater extraction in the Study Area from the North Coast Fractured and Porous Rock Groundwater Source (WSP still in draft) is estimated to be approximately 16,600 ML/year on average, of which approximately 8,000 ML/year on average is extracted by Centennial-owned sites. Peak extraction

from the groundwater source is predicted to occur in 2020 at an average rate of approximately 18,900 ML/year. Groundwater extraction by Myuna Colliery (3 Mtpa scenario) is predicted to peak at approximately 3,200 ML/year in 2020, which is approximately 15% of total groundwater extraction (from both Centennial-owned and non-Centennial sites) within the Study Area. This volume represents the WAL that Myuna Colliery will be required to obtain once the WSP commences in July 2015.

Current extraction of salt associated with groundwater extraction from the North Coast Fractured and Porous Rock Groundwater Source is estimated to be approximately 170,300 t/year on average with salinity of approximately 15,500 $\mu\text{S/cm}$. Salt extraction associated with groundwater extraction by all sites is expected to peak in 2020 at a rate of approximately 201,200 t/year with salinity of approximately 15,900 $\mu\text{S/cm}$. Salt associated with the extraction of groundwater by Myuna Colliery (3 Mtpa scenario) is predicted to peak in 2020 at approximately 85,000 t/year, which is approximately 40% of total salt extraction.

The total water discharges to the North Lake Macquarie Water Source are dominated by discharges from Eraring Power Station. Current total discharges are estimated to be 4.0 GL/year on average. This is expected to decrease to approximately 7,600 ML/year after 2030, when Eraring Power Station is expected to cease discharging with decommissioning of the power station.

Not considering discharges from Eraring Power Station, total discharges to the North Lake Macquarie Water Source are currently estimated to be approximately 8,900 ML/year. Peak discharge to the North Lake Macquarie Water Source is predicted to occur in 2019 at an average rate of 10,400 ML/year. Peak discharge from Myuna Colliery is predicted to be approximately 2,050 ML/year or 20% of total discharges to the North Lake Macquarie Water Source (excluding Eraring Power Station). The modelling indicates that the current volumetric discharge limits at LDP A and LDP B (Table 3) are sufficient for the life of the mine.

Current total discharges of salt to the North Lake Macquarie Water Source are also dominated by discharges from Eraring Power Station. Current total discharges are estimated to be approximately 148 Mtpa on average with salinity of approximately 56,000 $\mu\text{S/cm}$. This is predicted to decrease to approximately 10,600 t/year with salinity of approximately 2,100 $\mu\text{S/cm}$ after 2030, when Eraring Power Station is expected to cease discharging with decommissioning of the power station.

Not considering discharges from Eraring Power Station, current total discharges of salt to North Lake Macquarie Water Source are estimated to be approximately 61,700 t/year with salinity of 9,100 $\mu\text{S/cm}$. Salt discharged from all sites is predicted to peak in 2020 at a rate of approximately 63,700 t/year with salinity of approximately 9,300 $\mu\text{S/cm}$. Peak salt discharge from Myuna Colliery is predicted to be approximately 51,000 t/year, or 80% of total salt discharges to the North Lake Macquarie Water Source (excluding Eraring Power Station).

Overall, the modelling indicates that Myuna Colliery is a net water extraction site and a net store of salt. As outlined in the Hydrogeological Model Report attached, the increase in maximum coal extraction from 2 Mtpa to 3 Mtpa is predicted to result in a relatively small increase in peak groundwater inflow to the Myuna Colliery workings (from 7.5 to 7.9 ML/day). Licenced discharges are generally expected to remain unchanged and it is not considered that the volumetric limits at LDPs require reviewing.

7 References

DNRW (2007), *Measuring Salinity*, Kristie Watling, Queensland Government, Department of Natural Resources and Water.

GHD (2014) *Northern Operations Water and Salt Balance*. Report prepared for Centennial Coal.

GoldSim Technology Group (2011), *GoldSim Version 10.5*, (SP2).

Yours Sincerely

A handwritten signature in black ink, appearing to read 'Stuart Gray', is shown on a light gray background.

Stuart Gray

Senior Hydrogeologist
(02) 4979 9999

Attachment: Myuna Hydrogeological Model. Letter report prepared by GHD, 2014.



17 October 2014

James Wearne
Environmental Coordinator
Centennial Coal
PO Box 1000
TORONTO NSW 2283

Our ref: 22/17054
Your ref: 105807

Dear James

Northern Operations Water and Salt Balance Myuna Hydrogeological Model

GHD Pty Ltd (GHD) has revised the hydrogeological model for Myuna Colliery as part of the preparation of the Northern Operations Water and Salt Balance (GHD, 2014). The original hydrogeological model was developed in 2010 to support the Part 3A development application for Myuna Colliery (GHD, 2010).

The purpose of this letter is to:

- Provide an overview of the revised hydrogeological model, including data sources, the conceptual model, boundary conditions, material properties, calibration, assumptions and limitations.
- Show predicted groundwater inflows into the Myuna Colliery underground workings under current approved conditions.
- Provide predicted groundwater inflows into the Myuna Colliery underground workings under proposed conditions.

1 Introduction

1.1 Site Overview and Approved Conditions

Myuna Colliery is an existing underground coal mine located in Wangi Wangi on the western side of Lake Macquarie in the Newcastle Coalfields, approximately 25 kilometres south of Newcastle. Centennial Myuna Pty Ltd (Centennial Myuna) has owned and operated the mine since 2002.

Continuous miner bord and pillar operations have occurred at Myuna Colliery in the Wallarah, Great Northern and Fassifern seams since 1981. Centennial Myuna was granted approval in January 2012 under Project Approval 10_0080 to extract up to 2 million tonnes per annum (Mtpa) of run of mine (ROM) coal until 31 December 2032 within Consolidated Coal Lease 762 (CCL762) and Mining Lease 1370 (ML1370). Coal from Myuna is taken by dedicated overland coal conveyor to Eraring Power Station.

1.2 Proposed Conditions

Centennial Myuna is in the process of applying for a Modification to Project Approval 10_0080 to increase the extraction rate to 3 Mtpa of ROM coal within CCL762 and ML1370.

1.3 Objectives of the Hydrogeological Model

A hydrogeological model has been developed to predict future groundwater inflows into the underground workings to inform dewatering and discharge requirements.

2 Existing Environment

The existing geological, hydrogeological and surface water environment at Myuna Colliery is outlined in this section.

2.1 Landforms and Watercourses

The Myuna Colliery surface facilities area is located within the Wangi Creek catchment, which contributes to Lake Macquarie. The majority of existing workings within the Wallarah, Great Northern and Fassifern Seams are located beneath Lake Macquarie.

Ground elevations range from 0 m AHD to approximately 70 m AHD within the Myuna Colliery holding boundary.

2.2 Geology

The stratigraphy at Myuna is listed and described in Table 1. This information has been sourced from the Newcastle Coalfields Regional Geology 1:100,000 map (Edition 1 1995).

Table 1 Stratigraphic Sequence – Myuna Colliery

Period	Stratigraphy		Unit/Lithology	Coal Seams
	Group	Subgroup		
Quaternary			Alluvium	
Triassic	Narrabeen	Clifton	Conglomerate, sandstone, siltstone, claystone	
Permian	Newcastle Coal Measures	Moon Island Beach	Conglomerate, sandstone, siltstone, tuff, coal	Vales Point, Wallarah, Great Northern
		Awaba Tuff		
		Boolaroo	Sandstone, conglomerate, siltstone, coal, tuff	Fassifern, Upper Pilot, Lower Pilot, Hartley Hill
		Warners Bay Tuff		

The coal seams mined at Myuna Colliery are part of the late Permian Age Newcastle Coal Measures, which dips to the south east at a grade of generally less than 1 in 20. The Moon Island Beach, Awaba Tuff and Boolaroo Formations of the Newcastle Coal Measures outcrop and/or subcrop to the northwest, north, northeast, east and southeast of the Myuna Colliery holding boundary.

The Wallarah Seam ranges in thickness of between 2.0 m to 3.0 m across the Myuna Colliery holding boundary and is predominantly overlain by Karignan Conglomerate, described as a medium to coarse grained pebble conglomerate. The Dooralong Shale makes up the roof of the Wallarah Seam in the east and the Wallarah Seam is underlain by Mannering Park Tuff claystone/mudstone.

The Great Northern Seam generally varies in thickness of between 2.5 m to 3.0 m across the holding boundary. Teralba Conglomerate tends to form the roof of the Great Northern Seam in most areas, although this is replaced by shale, mudstone or tuffaceous siltstones in some areas. The Awaba Tuff siltstone/claystone underlies the Great Northern Seam in most areas.

Both the Wallarah and Great Northern Seams tend to split, deteriorate and thin along the north south zone to the west and south west of the holding boundary.

The Fassifern Seam is the most extensive coal reserve throughout the lease area, with a thickness in excess of 6.0 m in areas where the seam is not split. The seam is at its greatest thickness at Wangi Point. Between the Wangi Peninsula and Pulbah Island the seam splits in two. The lower split is the preferred mining section in this area. The splits coalesce to the south of Pulbah Island and beyond the Myuna Colliery holding boundary. Awaba Tuff generally overlies the Fassifern Seam, while the floor is composed of claystones.

2.3 Hydrogeology

The groundwater sources in the vicinity of Myuna Colliery are generally low yielding and predominantly within the Quaternary alluvium, weathered and/or fractured rock and coal seams.

2.3.1 Quaternary Water Sources

The Quaternary material includes alluvium, which occurs along the watercourses draining into Lake Macquarie, and lake sediment underlying Lake Macquarie. The alluvium forms an unconfined shallow aquifer with a thickness of up to 10 m and is managed under the Water Sharing Plan (WSP) for the Hunter Unregulated and Alluvial Water Sources. This WSP commenced in August 2009 and regulates the interception and extraction of surface water and alluvium within the defined WSP area.

2.3.2 Porous and Fractured Rock Water Sources

Groundwater flow within the Triassic and Permian rocks underlying the Myuna Colliery holding boundary is predominantly within the coal seams. The overburden and interseam strata tend to have very low hydraulic conductivities (unless fracturing creates a secondary permeability).

These water sources are not currently managed under a WSP, although it is understood that a WSP for the North Coast Fractured and Porous Rock Groundwater Sources is currently under development and is due to commence in July 2015.

3 Data Sources and Analysis

The hydrogeological model has been developed with reference to the Australian Groundwater Modelling Guidelines (Barnett et al., 2012). Based on the model objectives, the availability of existing data and the value of the groundwater sources, the model is considered to have a Class 2 level of confidence, as defined under the Guidelines. Class 2 models are considered to be suitable for providing estimates of dewatering requirements for mines.

This section outlines the initial process of data collation and analysis. Data requirements for the hydrogeological model can be divided into hydrogeological framework data, hydrological stress data and groundwater monitoring data. The hydrogeological framework data and hydrological stress data have generally been used to build and parameterise the model, whereas the groundwater monitoring data have been used in model calibration.

3.1 Hydrogeological Framework Data

Hydrogeological framework data includes extent, thicknesses and boundaries of geological (and aquifer) units, and aquifer properties (hydraulic conductivity, porosity, storage and specific yield). In typical modelling scenarios these parameters do not change over time, however in a mining context there may be changes due to rock fracturing and subsidence. These data have been sourced from the following:

- 1:100,000 Newcastle Coalfield Regional Geology map (NSW Department of Mineral Resources, 1995).
- Depth of cover and seam thickness drawings (supplied by Centennial Myuna).
- 10 m topographical contours (supplied by Centennial Myuna).
- Existing reports detailing hydrogeological properties of the upper Newcastle Coal Measures.
- Completed mine plans of Myuna Colliery in the Wallarah, Great Northern and Fassifern seams.

3.2 Hydrological Stress Data

Hydrological stress data includes the time varying hydrological data such as natural recharge, injection/extraction, drains, creeks and other sources and sinks. These data have been sourced from the following:

- Rainfall data (obtained from the Bureau of Meteorology (BOM)).
- Future coal production volumes for the Wallarah, Great Northern and Fassifern seams (supplied by Centennial Myuna) to assist in establishing drain cells and their periods of activation.
- Underground water extraction data.

Since the majority of underground mine workings at Myuna Colliery are under Lake Macquarie, Centennial Myuna does not have a groundwater monitoring program.

3.2.1 Rainfall Data

Net rainfall recharge of 0.024 m/year was adopted throughout the model domain, which is approximately 2% of annual rainfall at the Bureau of Meteorology (BOM) Cooranbong (Avondale) Station (station number 61012) located to the west of the Myuna Colliery holding boundary. Data from this station has been used at other Centennial Coal sites in the Newcastle Coalfield.

This net recharge is generally consistent with values used for Centennial Coal's other hydrogeological models in the Newcastle Coalfield.

3.2.2 Future Coal Production Volumes

Centennial Myuna has approval to produce up to 2 Mtpa of ROM coal within CCL762 and ML1370, however there is no mine plan for the life of mine. Therefore, the footprint of the future workings was calculated from the tonnage of coal reserves remaining (approximately 17.2 million tonnes), the bulk density of coal (taken as 0.83 tonnes/m³) and an average coal seam thickness of 3 m. The assumption was made that an equal area would be mined each year in each seam. Based on the results of this calculation it was assumed that a total area of approximately 2.3 million square metres would be mined from each seam up to 31 December 2032. This represents about 1 Mtpa of actual coal production due to the limited coal reserves. Actual production in recent years has generally been less than 1.6 Mtpa.

Under the proposal to increase production to 3 Mtpa, it was assumed that actual production would be 3 Mtpa. This equates to an area of approximately 0.4 million square metres mined from each seam per year from 2015. This would result in an exhaustion of the coal reserves within 6 years.

3.2.3 Underground Water Extraction Data

Daily underground water extraction is the only groundwater monitoring undertaken at Myuna Colliery. Daily extraction volumes recorded between January 2010 and November 2013 are shown in Figure 1.

The average underground water extraction during 2013 was 6.4 ML/day. Centennial Myuna has advised that the underground storages at Myuna Colliery are managed so that water levels generally remain constant. Therefore, it is assumed that the average extraction rate of 6.4 ML/day represents the average groundwater seepage for 2013.

The recorded data indicates that 40% of the extracted volumes are from the Wallarah Seam workings.

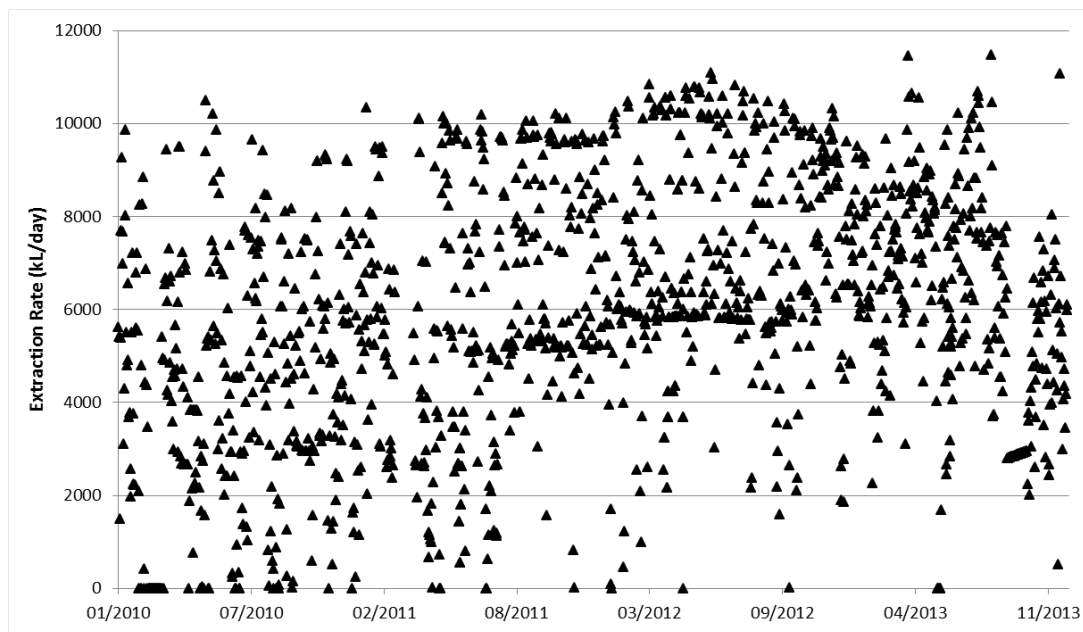


Figure 1 Total Underground Water Extraction – Myuna Colliery

4 Conceptual Model and Boundary Conditions

A conceptual model of groundwater sources at Myuna Colliery has been developed to define the hydrogeological domain, define boundary conditions (including sources and sinks to the groundwater sources), describe groundwater flow, nominate aquifer properties and outline model assumptions and limitations.

4.1 Hydrogeological Domain

The horizontal extent of the model was set to be approximately 2 kilometres (km) from the extent of any current mining at Myuna. Based on experience in the Newcastle Coalfield, the radius of groundwater depressurisation from mine workings is generally less than 2 km.

The vertical domain of the model extends from the ground surface to a depth of -250 m AHD. The model has been divided into four hydrogeological units:

- Quaternary (alluvium and lake sediment).
- Triassic (sandstone and conglomerate).
- Coal seams.
- Permian tuff and interburden.

4.2 Boundary Conditions and Groundwater Flow

The boundaries to the flow of groundwater within each hydrogeological unit are summarised in Table 2.

The alluvial groundwater sources are unconfined aquifers that are associated with the waterways within the hydrogeological domain. They extend to a maximum depth of 10 m bgl and are underlain by Triassic strata. The alluvial groundwater sources are recharged by net rainfall and catchment runoff (and by Lake Macquarie at lower elevations) and discharge into connected surface waterways (and into Lake Macquarie at lower elevations). Lake Macquarie is represented by a General Head Boundary (GHB) set at 1 m AHD. It is assumed that the flow of alluvial groundwater across the northern, eastern, western and southern boundaries of the hydrogeological domain is relatively small since the boundaries generally cross the upper catchments. Therefore, no flow boundaries have been defined in these areas.

Table 2 Model Boundary Condition Details

Hydrogeological Unit	Boundary Condition	Boundary Details
Quaternary strata (Layer 1)	Recharge	Net recharge (i.e. from rainfall and catchment runoff after evaporation) was initially set to approximately 2% of average annual rainfall across the land areas within Layer 1 of the model. This equates to a net recharge of approximately 0.024 m/year. The final recharge value was established through model calibration.

Hydrogeological Unit	Boundary Condition	Boundary Details
	General Head Boundary (GHB)	The lake sediment beneath Lake Macquarie has been defined by GHB cells set at 1 m AHD.
	No Flow	No flow boundaries have been defined where the alluvium intersects the northern, eastern, western and southern extents of the hydrogeological domain. These boundaries generally occur within the upper catchments where groundwater flow across these boundaries would be relatively low.
	Drain	Drain cells have been set at ground level throughout the extent of alluvium to simulate the removal of groundwater that seeps to the surface within drainage lines. Conductance values have been set to represent the hydraulic conductivity of the alluvium.
Triassic strata (Layers 1 and 2)	Recharge	Net recharge of 0.024 m/year applies in areas of subcrop of Triassic strata.
	GHB	The southern boundary is considered to be the down-gradient extent of this unit (within the modelled domain) and has been defined by GHB cells set at 0 m AHD.
	No Flow	The northern and western boundaries are considered to be no flow boundaries since these are generally the up-gradient extents of this unit (within the modelled domain).
Wallarrah Seam (Layer 3) Great Northern Seam (Layer 5) Fassifern Seam (Layer 7)	GHB	The southern boundary is considered to be the down-gradient extent of this unit (within the modelled domain) and has been defined by GHB cells set at 0 m AHD.
	No Flow	The northern and western boundaries are considered to be no flow boundaries since these are generally the up-gradient extents of this unit (within the modelled domain).
	Drain	Drain cells have been used to represent existing and future mine workings in each seam. Drain elevations have been set at the floor of each seam.
Permian tuff and interburden (Layers 4, 6 and 8)	GHB	The southern boundary is considered to be the down-gradient extent of this unit (within the modelled domain) and has been defined by GHB cells set at 0 m AHD.
	No Flow	The northern and western boundaries are considered to be no

Hydrogeological Unit	Boundary Condition	Boundary Details
		flow boundaries since these are generally the up-gradient extents of this unit (within the modelled domain) The base of Layer 8 has been defined as a no flow boundary and represents the vertical extent of the model.

Since there is no surface water level or flow data available, and the waterways are generally ephemeral and intermittent, it is assumed that all connected waterways are 'water-gaining' streams and function as drains. The alluvial groundwater discharges into these waterways (drains) at elevations corresponding to the elevations of the stream beds. In the case where alluvial groundwater rises to the ground surface, the resulting surface water flow must be removed from the model using drains.

The Triassic strata subcrops throughout the majority of the hydrogeological domain and is recharged by net rainfall in these areas. The piezometric head is assumed to reduce towards the south, reflecting the regional dip of the strata. Therefore the southern boundary of this unit is defined as a GHB, set at 0 m AHD.

The coal seams (Wallarrah, Great Northern and Fassifern) are confined porous/fractured rock groundwater sources. The piezometric head of these units is assumed to reduce towards the south, reflecting the dip of the strata. Therefore, like the Triassic unit, the southern boundary is defined as a GHB set at 0 m AHD. Drain cells have been used to represent existing and future workings throughout the hydrogeological domain. Drain elevations have been set at the floor of each seam.

The interbedded Permian layers are low yielding confined groundwater sources. GHBs have been defined as for adjacent units. The base of the model is defined by a no flow boundary and represents the vertical extent of the hydrogeological domain.

4.3 Material Properties

The material properties of each of the four hydrogeological units were derived from previous hydrogeological models developed by GHD for the Newcastle Coalfield. Pre-calibration values were assigned for hydraulic conductivity, porosity and storage parameters. These values are shown in Table 3. Final values were established through model calibration.

Table 3 Pre Calibration Hydrogeological Properties

Hydrogeological Unit	Model Layers	Horizontal Hydraulic Conductivity "K _h " (m/year)	Vertical Hydraulic Conductivity "K _v " (m/year)	Storage Parameters	Effective Porosity (n _e)
Quaternary	Layer 1	365	36.5	0.2 ^(a)	0.2
Triassic	Layers 1 & 2	3.65	0.365	0.00001 ^(b)	0.1

Hydrogeological Unit	Model Layers	Horizontal Hydraulic Conductivity "K _h " (m/year)	Vertical Hydraulic Conductivity "K _v " (m/year)	Storage Parameters	Effective Porosity (n _e)
Coal	Layers 3, 5 & 7	1.8	0.18	0.00001 ^(b)	0.1
Permian	Layers 4, 6 & 8	0.3	0.03	0.00001 ^(b)	0.1

(a) Specific yield

(b) Specific storage (1/m)

4.4 Model Assumption and Limitations

Since the hydrogeological model is based on limited data and a simplified conceptualisation of the hydrogeological system, it is necessary to make assumptions. Assumptions and limitations are outlined as follows:

- Potential groundwater impacts will not extend beyond the active area of the model. Based on previous hydrogeological modelling undertaken by GHD in the Newcastle Coalfields, the radius of depressurisation is generally within 1 km from the mine workings. The boundaries of the model have been set to be 2 km from all current workings.
- The water level of Lake Macquarie is constant since tidal variations are likely to have little effect on inflows into the deep underground workings.
- All other GHBs have constant piezometric head over time.
- Material properties are homogeneous throughout each hydrogeological unit. Material properties do not change with the degree of saturation.
- No fracturing occurs above the workings. This assumption is reasonable due to the bord and pillar mining method.
- Since groundwater utilisation in the vicinity of Myuna Colliery is low with relatively few registered bores, it is reasonable to assume that groundwater extractions from registered bores within the hydrogeological domain are negligible and are assumed to have a negligible effect on model results.
- No direct flow pathways will develop between the proposed workings and the ground surface or alluvium.
- Horizontal hydraulic conductivity is ten times the vertical hydraulic conductivity for each hydrogeological unit. This is a typical relationship for essentially horizontal strata.
- All workings (existing and proposed) remain fully drained until the completion of mining operations at Myuna Colliery.

5 Numerical Model Construction and Calibration

5.1 Model Software

Numerical modelling was undertaken using the MODFLOW-NWT solver with the Upstream Weighting flow package. MODFLOW-NWT is a version of MODFLOW 2005 that provides a different formulation of the groundwater flow equation (Newton formulation) designed to solve models that are non-linear due to unconfined cells or non-linear boundary conditions. MODFLOW 2005 is a three-dimensional finite difference groundwater flow model from the United States Geological Survey (USGS) and is one of the industry standard codes for numerical groundwater modelling. The model was built using the Groundwater Modelling System (GMS) graphical user interface. GMS is a three-dimensional user interface for the MODFLOW groundwater modelling code.

It was considered that MODFLOW-NWT and GMS incorporates the features to adequately fulfil the model objectives.

5.2 Model Construction

The active modelling area covers approximately 114 km², extending from N: 6332000 and E: 363500 in the southwest to N: 6344000 and E: 373000 in the northeast. The maximum east-west and north-south extents are approximately 9.5 km and 12.0 km respectively. Active and inactive cells were defined by the available geological data and geological boundaries.

The area has been divided into a grid consisting of 190 columns and 240 rows, generating equally sized cells with dimensions 50 m × 50 m. It was considered that this degree of discretisation of the model domain would provide adequate refinement throughout the main areas of interest (mine workings) without leading to excessive model run times.

The model has been divided into eight layers of varying thicknesses. In total, the model consists of 364,800 active cells. The top and base elevations of each layer are defined in Table 4.

Table 4 Vertical Extent of Model Layers

Layer	Hydrogeological Units	Top	Base
1	Quaternary and Triassic	Topographic Contours	Topographic Contours – 10 m
2	Triassic Conglomerate	Topographic Contours – 10 m	Topographic Contours – 50 m
3	Wallarah Seam	Bottom of Layer 2	Bottom of Layer 2 – 2.5 m
4	Permian Inter burden	Wallarah Seam Floor	Great Northern Seam Roof
5	Great Northern Seam	Seam elevation data (supplied by Centennial)	Great Northern Seam Roof – 3 m

Layer	Hydrogeological Units	Top	Base
6	Permian Interburden (Awabakuff)	Great Northern Seam Floor	Fassifern Seam Roof
7	Fassifern Seam	Seam elevation data (supplied by Centennial)	Fassifern Seam Roof -3.5 m
8	Permian	Fassifern Seam Floor	-250 m AHD

5.3 Steady State Calibration

The hydrogeological model was initially run under steady state conditions. The steady state heads were used to define initial head conditions for the transient model. Steady state calibration was not undertaken due to the absence of groundwater level data.

5.4 Transient Calibration

The transient model was run in calibration mode from 1980 (two years prior to the commencement of coal production in 1982) to 2013, using annual stress periods and yearly time steps. The steady state groundwater levels were used as the starting head levels for the transient model.

As outlined in Table 2, drain cells were established throughout Layers 3, 5 and 7 to coincide with the development of existing workings within the Wallarah, Great Northern and Fassifern seams between 1980 and 2013. The transient model was calibrated by adjusting horizontal and vertical conductivities of the coal seam, the Triassic overburden (Layer 2) and Permian interburden material (Layers 4, 6 and 8) to meet the following criteria:

- The modelled groundwater inflow into the existing Myuna workings in 2013 to be equal to the average recorded underground water extraction rate during that year of 6.4 ML/day.
- To replicate the observed condition of approximately 40% of total underground water extraction coming from the Wallarah Seam (Section 3.2.3).

Net recharge was set to 0.024 m/year and remained constant for each year of the model so that results were not affected by non-average rainfall.

Table 5 gives the results of 10 transient model runs. By varying the hydraulic conductivities of coal, Permian and Triassic units it was possible to replicate the total recorded extraction rate in 2013 however it was not possible to replicate the observed condition of 40% of total extraction coming from the Wallarah seam (see Runs 1 to 8). It was necessary to increase the thickness of Layer 2 by 30 m to model an acceptable groundwater inflow into the Wallarah Seam (see Runs 9 and 10). This was considered reasonable since the majority of workings within the Wallarah Seam are overlain by at least 70 m of rock.

It was considered that the calibration achieved by Run 10 is acceptable at this stage.

Table 5 Hydraulic Conductivity Values for Transient Runs and Results

Model Run	Coal Seams K_h (m/year)	Triassic K_h (m/year)	Permian K_h (m/year)	Layer 2 Thickness (m)	Walarah seam inflow as % of total extractions (%)	Year 2013 Total Modelled Groundwater Inflow (ML/day)
1	1.8	3.65	0.01	40	98	13.8
2	0.3	3.65	0.01	40	98	10.6
3	0.3	0.365	0.01	40	88	2.1
4	0.3	0.73	0.01	40	93	3.3
5	0.3	1.46	0.01	40	96	5.5
6	3.0	0.365	0.01	40	85	2.5
7	3.0	0.73	0.01	40	90	3.9
8	3.0	1.4	0.01	40	94	6.3
9	1.8	0.6	0.15	70	51	6.1
10	1.8	0.6	0.2	70	48	6.4

6 Predictive Simulations

The calibrated hydrogeological model was used to provide estimates of future groundwater inflows and dewatering volumes under approved and proposed conditions.

The calibrated transient model (Run 10) was extended to the end of year 2200 to cover the period of proposed mining in 2032 as well as the period of re-pressurisation of groundwater sources following completion of mining. Drain cells were established throughout Layers 3, 5 and 7 in accordance with the proposed mining schedule discussed in Section 3.2.2. All workings remain fully drained until the completion of mining.

6.1 Approved Conditions

Figure 2 shows the total predicted groundwater inflows into the Myuna workings under approved conditions for transient Run 10 up to the year 2200. Groundwater inflows are predicted to peak at 7.5 ML/day in year 2032.

The original hydrogeological model predicted that groundwater inflows would peak at 28.4 ML/day, and 8.3 ML/day would be extracted (GHD, 2010). This original model assumed that only a proportion of groundwater inflow was extracted within each seam, resulting in ongoing flooding of some areas of old

workings. The revised model is based on advice from Centennial Myuna that all groundwater inflow is extracted.

6.2 Proposed Conditions

Figure 2 shows the total predicted groundwater inflows into the Myuna workings under proposed conditions for transient Run 10 up to the year 2200. Groundwater inflows are predicted to peak at 7.9 ML/day in year 2020.

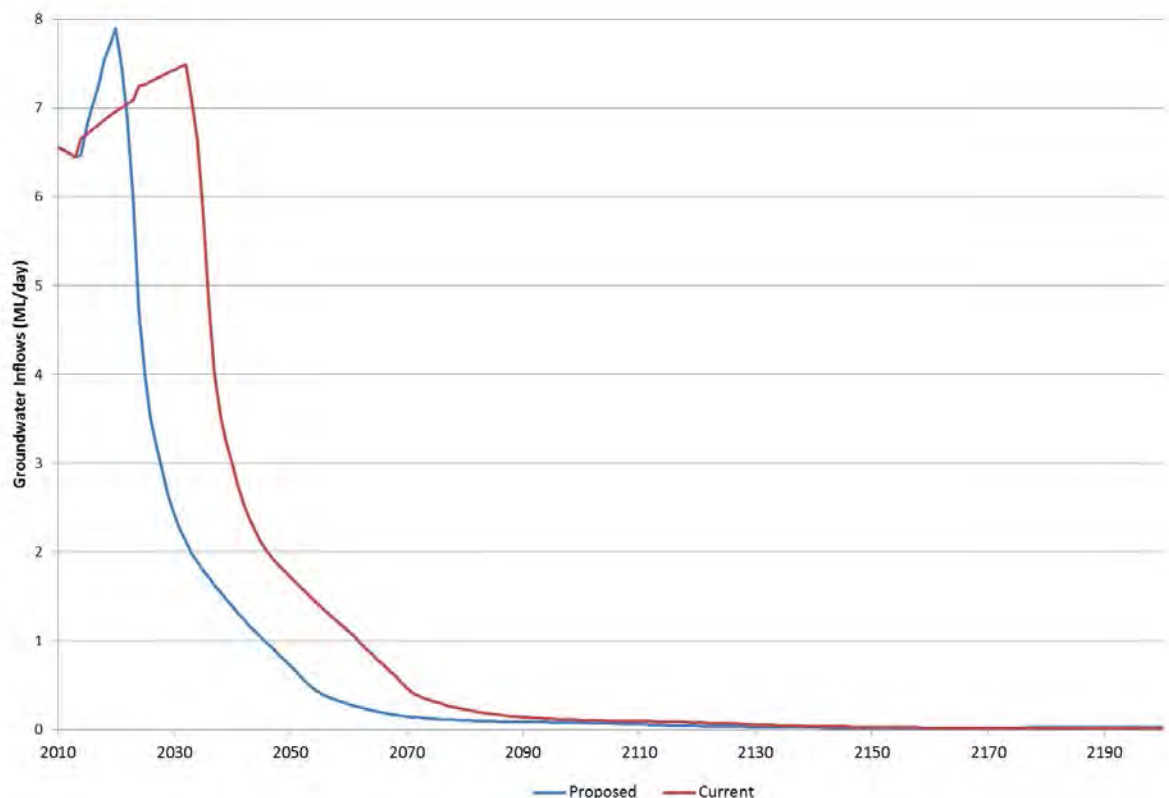


Figure 2 Modelled Groundwater Inflows under Approved and Proposed Conditions

7 Conclusions

A three dimensional eight layer numerical hydrogeological model has been constructed to estimate groundwater inflow into the underground workings at Myuna Colliery up to 2200. The results of this modelling have been incorporated into the Northern Regional Water and Salt Balance.

Hydrogeological modelling was undertaken using the MODFLOW-NWT solver of the MODFLOW 2005 groundwater modelling code. The model was constructed using the GMS graphical user interface with reference to the NSW Aquifer Interference Policy and Australian Groundwater Modelling Guidelines (Barnett et al., 2012). Model assumptions and limitations are detailed in Section 4.4.

The hydrogeological model was calibrated under transient conditions using available underground water extraction data.

Based on the results from transient Run 10 (best fit run under transient calibration), total groundwater inflows into the Myuna workings under approved conditions are predicted to peak at approximately 7.5 ML/day in year 2032. For the proposed extraction rate of 3 Mtpa, total groundwater inflow into the Myuna workings is predicted to peak at approximately 7.9 ML/day in 2020.

The hydrogeological model is based on the groundwater data, geological data and mining plan available at the time of model construction. It may be necessary to update this hydrogeological model in the future based on future groundwater monitoring data.

8 References

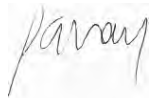
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Yours Sincerely



Stuart Gray

Senior Hydrogeologist
(02) 4979 9999



Centennial Coal

Centennial Coal Company Limited
P O Box 1000
Toronto NSW 2283
www.centennialcoal.com.au

